SOIL SURVEY OF

Alfalfa County, Oklahoma

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Oklahoma Agricultural Experiment Station

Issued February 1975

Major fieldwork for this soil survey was done in the period 1960–70. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Alfalfa County Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Alfalfa County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by may symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site, the tame pasture suitability group, and the tree suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and the tame pasture and tree suitability groups.

Foresters and others can refer to the section "Use of the Soils for Planting Trees," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife Habitat."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices and structures.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Alfalfa County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of this publication and in the section "General Nature of the County."

Cover: **Harvesting alfalfa on Dale silt loam, 0 to 1 percent slopes.**

Contents

Issued February 1975

SOIL SURVEY OF ALFALFA COUNTY, OKLAHOMA

BY GLEN E. WILLIAMS AND EDWARD S. GROVER, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH OKLAHOMA AGRICULTURAL EXPERIMENT STATION

ALFALFA COUNTY is in the northern part of the State of Oklahoma, adjacent to the State of Kansas (fig. 1). Adjacent counties in Oklahoma are Grant, Gar-

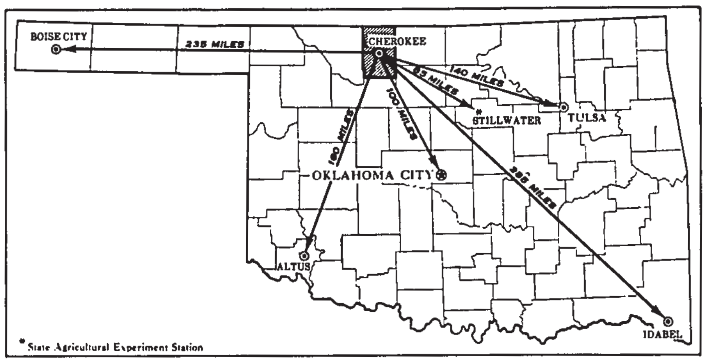

Figure 1.—Location of Alfalfa County in Oklahoma.

field, Major, and Woods. Adjacent counties in Kansas, to the north, are Barber and Harper. Cherokee, in the central part of the county, is the county seat. The total area of the county is 554,880 acres.

Farming is the main enterprise. A large part of the farm income is derived from sales of beef cattle and small grains, principally wheat, but alfalfa, sorghum, and grasses grown for tame pasture are important crops in some parts of the county. The size of farm units is expanding rapidly.

In a large part of the acreage, the soils have few limitations to use and are well suited to crops. More than 80 percent of the total acreage in farms consists of arable soils, although careful management is required if the sandy soils are cultivated. The soils in large areas are nearly level or very gently sloping, are loamy and fertile, and are easily farmed. Soils occupying several thousand acres, however, are affected, to some extent, by soluble salts.

The Pond Creek and Grant soils are used mainly to grow wheat. On many farms where these soils are dominant, wheat is used to graze beef cattle in winter. Alfalfa is grown on the Dale, Brewer, Reinach, and McLain soils.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Alfalfa County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Pond Creek and Drummond, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Grant silt loam, 1 to 3 percent slopes, is one of several phases within the Grant series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit

is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Alfalfa County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Carwile-Attica complex, 0 to 3 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Yahola and Port soils, frequently flooded, is an example.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Alfalfa County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this county have been grouped into three general kinds of landscape for interpretative purposes. Each of these broad groups and their included soil associations are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, the word "loamy" in the title of association 1 refers to the texture of the surface layer.

Deep, Loamy or Sandy, Rapidly Through Moderately Permeable Soils on Uplands

The four associations in this group make up about 25 percent of Alfalfa County. The soils are used mainly for field crops and as native range. They are used less extensively as tame pasture.

1. Albion association

Nearly level through moderately steep, well drained or somewhat excessively drained loamy soils

This association is on uplands. It makes up about 3 percent of Alfalfa County. About 85 percent of the association is Albion soils. The rest consists of Crisfield, Grant, Pratt, and Shellabarger soils, and of small areas of other soils.

Albion soils are nearly level to moderately steep, are deep, and are well drained or somewhat excessively drained. They have a loamy surface layer and a loamy subsoil.

Soils of this association have high available water capacity. They are used extensively for tame pasture and for cultivated crops, mostly small grains and grain sorghum. Maintaining adequate soil fertility and providing protection from soil blowing and water erosion are the main concerns of soil management.

2. Attica-Pratt-Shellabarger association

Nearly level through sloping, well drained loamy and sandy soils

This association is on uplands that have been modified by wind in many places. It makes up about 16 percent of

the county. About 35 percent of the association is Attica soils, 25 percent is Pratt soils, and 12 percent is Shellabarger soils. The rest consists of Aline, Carwile, Crisfield, Dillwyn, Dougherty, Drummond, Goltry, Grant, Pratt, and Ruella soils, and of small areas of other soils.

Attica soils, on undulating, wind-modified uplands, are nearly level through gently sloping and are deep and well drained. They have a loamy or a sandy surface layer and a loamy subsoil.

Pratt soils, also on undulating, wind-modified uplands, are nearly level through sloping and are deep and well drained. They are sandy throughout.

Shellabarger soils, on uplands, are very gently sloping and are deep and well drained. They have a loamy surface layer and a loamy subsoil.

Soils of this association have moderate or high available water capacity. They are used mainly for growing small grains and grain sorghum. To a lesser extent, they are used for alfalfa and for grasses grown for tame pasture. A small part of the acreage is used as native range. Where cultivated crops are grown, the main concerns of soil management are providing protection from soil blowing and water erosion and maintaining desirable soil structure and fertility.

3. Goltry-Dillwyn association

Nearly level or very gently sloping, moderately well drained or somewhat poorly drained sandy soils

This association consists of soils on uplands and on valley floors of uplands. It makes up about 1 percent of the county. About 55 percent of the association is Goltry soils, and 40 percent is Dillwyn soils. The rest consists of Dougherty and Pratt soils.

Goltry soils are on undulating uplands and are nearly level or very gently sloping. They are deep, are moderately well drained, and are sandy throughout.

Dillwyn soils, on valley floors of uplands, are also nearly level or very gently sloping. They are deep, are somewhat poorly drained, and are sandy throughout.

In normal times a high water table provides extra moisture that is beneficial to crops grown on the soils of this association. During extremely wet periods, the high water table hinders cultivation and adds excess moisture that is detrimental to crops. More than half of the acreage is used as native range. The rest is mainly in tame pasture or is used for cultivated crops, chiefly small grains and grain sorghum. A small acreage is used to grow alfalfa. Controlling soil blowing and maintaining adequate soil fertility are the main concerns of soil management.

4. Tivoli-Aline association

Nearly level through steep, excessively drained or somewhat excessively drained sandy soils

This association consists of sandy, duny soils, mostly on uplands in the northeastern part of Alfalfa County. It makes up about 5 percent of the county. About 58 percent of the association is Tivoli soils, and 35 percent is Aline soils. The rest consists of Dillwyn, Goltry, Lincoln, Pond Creek, Pratt, and Yahola soils, and of small areas of other soils.

Tivoli soils, on duned uplands, are steep and are deep and excessively drained. They are sandy throughout.

Aline soils, on uplands, are nearly level through strongly sloping and are deep and somewhat excessively drained. They also are sandy throughout.

Soils of this association have low to moderate available water capacity. They are used mainly as range and are well suited to tall grasses if grazing is well managed and if other management is good. The range grasses are easily overgrazed, however, because these soils do not hold enough moisture to sustain the growth of plants for long periods of time. Fires, overgrazing, and spells of dry weather sometimes start active blowouts.

Areas not in range are used mainly for small grains, grain sorghum, and tame pasture. In cultivated areas controlling soil blowing and maintaining adequate soil fertility are the main concerns of soil management.

Deep Through Shallow, Loamy, Moderately Rapidly Through Very Slowly Permeable Soils on Uplands or Terraces

In this group are five soil associations that together make up about 60 percent of Alfalfa County. The soils are used primarily for cultivated crops, but small acreages are used as tame pasture or as native range.

5. Renfrow-Tabler association

Nearly level or very gently sloping, deep, well drained or moderately well drained soils on uplands

Soils of this association are on uplands. They make up about 2 percent of the county. About 60 percent of the association is Renfrow soils, and 30 percent is Tabler soils. The rest consists of Grant and Pond Creek soils.

Renfrow soils are on broad, smooth uplands and are nearly level and very gently sloping. They are deep, are well drained, and have a loamy surface layer and a clayey subsoil.

Tabler soils, also on broad uplands, are nearly level and are deep and moderately well drained. They have a loamy surface layer and a clayey or loamy subsoil.

Soils of this association have high available water capacity. They are better suited to wheat and to other winter crops than to crops that are grown in summer. Most of the acreage is used for wheat and other small grains, but small acreages are used for alfalfa, grain sorghum, and tame pasture. The soils are suited to use of the large farm machinery needed for planting and harvesting crops. Providing protection from water erosion and increasing the intake of water by maintaining desirable soil structure are the main concerns of soil management. Surface drainage is needed in small areas.

6. Pond Creek-Grant association

Nearly level through strongly sloping, deep, well drained soils on uplands

This association consists of soils on broad uplands that are dissected by creeks in a few places. Throughout more than 95 percent of the acreage, the soils are nearly level through gently sloping. Soils that occupy the remaining small acreage are sloping or strongly sloping and are mostly near intermittent drainageways.

This association makes up about 31 percent of this county. About 50 percent of the association is Pond Creek soils, and 42 percent is Grant soils. The rest consists of Albion, Attica, Nash, Ports, Quinlan, Renfrow, Ruella, Tabler, and Woodward soils, and of small areas of other soils.

Pond Creek soils are on smooth uplands. They are nearly level or very gently sloping, are deep and well drained, and have a loamy surface layer and a loamy subsoil.

Grant soils are mostly very gently sloping or gently sloping, but they are strongly sloping in places. Like the Pond Creek soils, the Grant soils are deep, are well drained, and have a loamy surface layer and a loamy subsoil.

Soils of this association have high available water capacity. Nearly all of the acreage is cultivated. Small grains and grain sorghum are the principal crops, but alfalfa is also grown, and grasses for tame pasture are grown to some extent. These soils are well suited to the use of the large farm machinery needed for planting and harvesting crops. In most years they can be tilled without excessive delays caused by unfavorable soil moisture. Providing protection from water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Response to intensive management is good.

7. *Dale-Reinach-Brewer association*

Nearly level through sloping, deep, well drained or moderately well drained soils on terraces

In this association are soils on broad terraces. The soils in about 90 percent of the association are nearly level. In about 10 percent, they are gently sloping and sloping.

This association makes up about 15 percent of the county. About 53 percent of the association is Dale soils, 19 percent is Reinach soils, and 13 percent is Brewer soils. The rest consists of Attica, Dillwyn, Drummond, Grant, McLain, Pond Creek, Port, Pratt, Tabler, and Yahola soils and of small areas of other soils.

Dale soils are on terraces that are dissected in places by drainageways and creeks. They are nearly level through sloping but are gently sloping or sloping in areas near drainageways. Dale soils are deep, dark colored, and well drained, and they have a loamy surface layer and a loamy subsoil. They are free of salts or are only slightly affected by salts below a depth of 40 inches.

Reinach soils are nearly level and are deep and well drained. They have a loamy surface layer and a loamy subsoil.

Brewer soils, also nearly level and deep, are moderately well drained. They have a loamy surface layer and a loamy subsoil. Brewer soils are free of salts or are only slightly affected by salts below a depth of 40 inches.

Soils of this association have high available water capacity. Nearly all of the acreage is used for tame pasture or for cultivated crops, mainly small grains, grain sorghum, and alfalfa. These soils are well suited to the use of the large machinery needed for planting and harvesting crops. During wet periods, however, wetness of some areas of Brewer and McLain soils sometimes delays tillage, and the soils in low spots are subject to infrequent flooding. Protecting the low areas from flooding and maintaining desirable soil structure and fertility are the main concerns of soil management. Response to intensive management is good.

According to information obtained by making test holes, a large quantity of water is available beneath some areas of this association. This water is too salty to be suitable for irrigation.

8. *Quinlan-Woodward-Grant association*

Very gently sloping through strongly sloping, shallow, moderately deep or deep, well drained soils on uplands

Soils of this association are on the crests and upper side slopes of uplands. They make up about 7 percent of the county. About 24 percent of the association is Quinlan soils, 24 percent is Woodward soils, and 20 percent is Grant soils. The rest consists of Dale, Grant, Nash, Pond Creek, Port, Pratt, Shellabarger, and Yahola soils, and of small areas of other soils.

Quinlan soils are very gently sloping through strongly sloping and are shallow and well drained. They have a loamy surface layer and a loamy subsoil.

Woodward soils, also very gently sloping through strongly sloping, are moderately deep and are well drained. They, too, have a loamy surface layer and a loamy subsoil.

Grant soils, like the Quinlan and Woodward soils are very gently sloping through strongly sloping and have a loamy surface layer and a loamy subsoil. They are deep and well drained.

Soils of this association have low through high available water capacity. They are used mainly for small grains, but small acreages are used for grain sorghum, forage sorghum, tame pasture, and native range. The main concerns of soil management are maintaining desirable soil structure and fertility and protecting the soils from water erosion.

9. *Albion-Quinlan-Woodward association*

Sloping through steep, shallow, moderately deep or deep, well drained or somewhat excessively drained soils on uplands

This association is in the most uneven parts of Alfalfa County and has within its boundaries the beginnings of many local drainageways. It makes up about 5 percent of the county. About 25 percent of the association is Albion soils, 22 percent is Quinlan soils, and 14 percent is Woodward soils. The rest consists of Crisfield, Drummond, Grant, Nash, Pond Creek, Port, Pratt, Shellabarger, and Yahola soils, and of small areas of other soils.

Albion soils, on the crests and the side slopes of uplands, are sloping through moderately steep. They are deep, are well drained or somewhat excessively drained, and have a loamy surface layer and a loamy subsoil.

Areas of Quinlan and Woodward soils are intermingled and occur in a complex pattern. Quinlan soils, on the crests and the upper side slopes of uplands, are sloping through steep. They are shallow, are well drained, and are loamy throughout. Woodward soils, on the crests and the side slopes of uplands, are also sloping through steep. They are moderately deep, are well drained, and have a loamy surface layer and loamy subsoil.

Soils of this association have low through high available water capacity. They are used mostly as range, but

small areas are used as tame pasture. Because these soils are somewhat droughty, protecting them from overgrazing is a major concern of soil management.

Some parts of this association that are occupied by Albion soils are underlain by deposits of gravel. This gravel is quarried and is used extensively as material for building roads.

Deep, Loamy or Sandy, Rapidly Through Very Slowly Permeable Soils on Flood Plains or Terraces

The four associations in this group make up about 15 percent of this county. The soils are used mainly for cultivated crops or as native range, but small acreages are used as tame pasture and for recreation, flood storage, and wildlife habitat.

10. Brewer-Dale association

Nearly level, well drained or moderately well drained loamy soils on terraces

This association consists of soils on broad terraces. It makes up about 3 percent of the county. About 38 percent of the association is Brewer soils, and 37 percent is Dale soils. The rest consists of Carwile, Drummond, Gracemont, McLain, Port, Pratt, Reinach, and Yahola soils, and of small areas of other soils. The soils are saline within the root zone of plants. Those in small concave areas tend to be saline higher in the profile than do the soils in surrounding areas.

Brewer soils are nearly level, are deep, and are moderately well drained. They have a loamy surface layer and a loamy subsoil. Below a depth of 40 inches. Brewer soils are moderately or strongly affected by salinity.

Dale soils are nearly level and are deep and well drained. They also have a loamy surface layer and a loamy subsoil. Below a depth of 40 inches, the root zone of Dale soils is strongly or moderately affected by salinity.

In this association the available water capacity of the soils is reduced by the salts below a depth of 40 inches. The soils are mainly for small grains and alfalfa, but part of the acreage is in grain sorghum and tame pasture. Because of salinity and the crusting of the surface layer, a good stand of crops is difficult to obtain, and yields are generally low.

11. Yahola-Port-Lincoln association

Nearly level or very gently sloping, well drained or somewhat excessively drained loamy or sandy soils on flood plains

This association is in areas where flooding is a major hazard to crops. It makes up about 6 percent of the county. About 56 percent of the association is Yahola soils, 24 percent is Port soils, and 11 percent is Lincoln soils. The rest consists of Brew, Crisfield, Dale, Gracemont, Grant, McLain, Miller, and Reinach soils, and of small areas of other soils.

Yahola soils, on slightly uneven flood plains, are nearly level and are deep and well drained. They have a loamy or sandy surface layer and are underlain by loamy or sandy material. Yahola soils are free of salts or are only slightly affected by salinity below a depth of 40 inches.

Port soils, also on flood plains, are nearly level or very gently sloping and are deep and well drained. They have a loamy surface layer and a loamy subsoil. Port soils are free of salts or are only slightly affected by salinity below a depth of 40 inches.

Lincoln soils, on uneven flood plains, are nearly level or very gently sloping, are deep, and are somewhat excessively drained. They have a sandy or a loamy surface layer and are underlain by stratified, generally sandy material. Lincoln soils, like the other soils of this association, are free of salts or are only slightly affected by salinity below a depth of 40 inches.

Soils of this association have low to high available water capacity. The Yahola and Port soils are used mainly for alfalfa, grain sorghum, tame pasture, and small grains. Protecting these soils from flooding and erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. The Lincoln soils are used mainly as native range, but some areas are in tame pasture. For those soils, protection from overgrazing is necessary. Where the range plants have been overgrazed and are therefore in poor condition, their roots are not long enough to use the moisture provided by the water table.

12. Gracemont-Drummond association

Nearly level or very gently sloping, somewhat poorly drained loamy soils on flood plains or terraces

This association consists of soils that are moderately or strongly affected by salts. It makes up about 3 percent of the county. About 70 percent of the association is Gracemont soils, and 18 percent is Drummond soils. The rest consists of Carwile, Lincoln, McLain, Pratt, and Yahola soils, and of small areas of other soils.

Gracemont soils, on broad flood plains, are nearly level and are deep, somewhat poorly drained, and moderately or strongly affected by salts. They have a loamy surface layer and are underlain by loamy material.

Drummond soils, on terraces, are nearly level or very gently sloping and are deep, somewhat poorly drained, and moderately or strongly affected by salts. They have a loamy surface layer and a clayey or loamy subsoil.

Because the soils of this association contain salts, they have only moderate or low available moisture capacity. Salinity and surface crusting are major limitations to their use, but maintaining adequate fertility is also a major concern of soil management. The soils are used as range or tame pasture. In areas used as range, alkali sacaton, inland saltgrass, and other undesirable salt-tolerant plants increase if livestock are allowed to overgraze. Obtaining a good stand of bermudagrass, tall wheatgrass, or other desirable grasses is generally difficult in tame pastures.

13. Salorthids association

Nearly level, somewhat poorly drained loamy or sandy soils on flood plains

Locally, the areas occupied by this association are called salt plains or salt flats. The soils are on flood plains. They make up about 3 percent of the county.

Salorthids occupy nearly all of the acreage, but small acreages are occupied by Gracemont and Lincoln soils and by small areas of other soils.

Salorthids are nearly level and are deep and somewhat poorly drained. They are loamy or sandy and are underlain by loamy or sandy stratified material. These soils are strongly affected by salinity. After dry periods, a white crust of salt forms on their surface.

Because of the high content of salts, soils of this association have low available water capacity and are mostly devoid of vegetation. In some places the water table is at the surface. In others it is at a depth of as much as 3 feet. The soils are used for recreation, for flood storage for the Great Salt Plains Reservoir, and for wildlife habitat.

Descriptions of the Soils

This section describes the soil series and mapping units in Alfalfa County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs. The description of each mapping unit contains suggestions on how the soil can be managed.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or there are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and tame pasture and tree suitability groups in which the mapping unit has been placed. The capability unit in which each mapping unit has been placed, and the page for the description of each range site, tame pasture suitability group, tree suitability group, or other interpretative group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary. More detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

[1] Italic numbers in parentheses refer to Literature Cited, p. 74.

Albion Series

The Albion series consists of nearly level through moderately steep, well-drained and somewhat excessively drained soils on uplands. These soils formed in sandy and gravelly sediment under a cover of tall and mid grasses.

In a representative profile, the surface layer is brown sandy loam about 8 inches thick. The upper part of the subsoil is brown sandy loam that extends to a depth of about 18 inches. The lower part of the subsoil is reddish-brown sandy loam that extends to a depth of about 32 inches. The underlying material is stratified and consists of yellowish-red gravelly sand and of thin layers of firm sandy loam as much as 1 inch thick.

Available water capacity is high. Permeability is moderately rapid.

Representative profile of Albion sandy loam, 1 to 3 percent slopes, 2,200 feet east and 200 feet north of the southwest corner of sec. 6, T. 25 N., R. 9 W.:

Ap—0 to 8 inches, brown (7.5YR 5/3) sandy loam, dark brown (7.5YR 3/3) moist; moderate, fine, granular structure; hard, friable; many roots; slightly acid; clear, smooth boundary.

B2t—8 to 18 inches, brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, granular; hard, friable; many roots and pores; few pebbles; patchy clay films on surfaces of peds; slightly acid; diffuse, irregular boundary.

B3—18 to 32 inches, reddish-brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; weak, coarse, prismatic structure; slightly hard, very friable; neutral; diffuse, irregular boundary.

IIC—32 to 75 inches, yellowish-red (5YR 5/6) gravelly sand, yellowish red (5YR 4/6) moist; single grained; loose, very friable; about 30 percent of horizon is thin layers of fine sandy loam as much as 1 inch thick; neutral.

The A horizon is brown or dark-brown, medium acid or slightly acid sandy loam or loam. In some places a few pebbles, as much as 1 inch in diameter, are in the A and B horizons. The B2t horizon is reddish-brown, yellowish-red, reddish-yellow, or brown sandy loam or loam that is slightly acid through mildly alkaline. The B3 horizon is reddish-brown, reddish-yellow, yellowish-red, or light-brown sandy loam that also is slightly acid to mildly alkaline. A IIC horizon of yellowish-red, reddish-yellow, or reddish-brown sand or gravelly sand underlies the B3 horizon. Reaction of the IIC horizon is neutral through moderately alkaline.

Albion soils are associated with Pratt, Crisfield, Drummond, Grant, and Pond Creek soils, and they have a profile similar to those of Shellabarger and Attica soils. They have a more clayey B horizon than Pratt soils; have more profile development than Crisfield soils; and have a less clayey B horizon than Drummond, Grant, Pond Creek, and Shellabarger soils. Albion soils have coarser sand and more gravel in the C horizon than Attica soils.

Albion sandy loam, 0 to 1 percent slopes (AbA).—This nearly level soil is on uplands. The surface layer and the subsoil are slightly thicker than the ones in the profile described as representative of the Albion series.

Included with this soil in mapping were areas of soils that have a similar profile but that have dark colors extending to a depth of 20 to 32 inches. About 40 percent of the total acreage in this mapping unit consists of these included areas. Other inclusions consist of a few small areas of Shellabarger soils.

This Albion soil is used mainly for small grains or

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Albion sandy loam, 0 to 1 percent slopes	1, 680	0. 3
Albion sandy loam, 1 to 3 percent slopes	8, 415	1. 5
Albion sandy loam, 3 to 5 percent slopes	1, 920	. 4
Albion sandy loam, 5 to 15 percent slopes	6, 020	1. 1
Albion-Grant complex, 3 to 5 percent slopes	2, 465	. 4
Albion-Grant complex, 3 to 5 percent slopes, eroded	1, 415	. 3
Albion-Grant complex, 5 to 8 percent slopes, eroded	1, 905	. 4
Aline fine sand, 0 to 3 percent slopes	7, 945	1. 4
Aline-Tivoli complex, 5 to 12 percent slopes	19, 205	3. 5
Attica loamy fine sand, 0 to 3 percent slopes	10, 945	2. 0
Attica fine sandy loam, 0 to 3 percent slopes	11, 205	2. 0
Attica fine sandy loam, 3 to 5 percent slopes	3, 420	. 6
Brewer silt loam	10, 520	1. 9
Brewer-Drummond complex	7, 630	1. 4
Carwile-Attica complex, 0 to 3 percent slopes	15, 085	2. 7
Crisfield fine sandy loam	3, 905	. 7
Dale silt loam, 0 to 1 percent slopes	37, 935	6. 8
Dale silt loam, saline	6, 095	1. 1
Dale soils, 3 to 8 percent slopes	4, 975	. 9
Dillwyn loamy fine sand	2, 775	. 5
Dougherty fine sand, 0 to 3 percent slopes	4, 375	. 8
Drummond soils, 0 to 3 percent slopes	2, 685	. 5
Drummond-Pratt complex, 0 to 3 percent slopes	1, 470	. 3
Goltry fine sand, 0 to 3 percent slopes	3, 830	. 7
Gracemont soils	13, 770	2. 5
Grant silt loam, 1 to 3 percent slopes	45, 690	8. 2
Grant silt loam, 3 to 5 percent slopes	14, 570	2. 6
Grant silt loam, 3 to 5 percent slopes, eroded	9, 415	1. 7
Grant-Nash complex, 3 to 8 percent slopes, eroded	19, 455	3. 5
Grant-Port complex, 0 to 12 percent slopes	8, 955	1. 6
Lincoln soils	4, 055	. 7
McLain silt loam	4, 905	. 9
Miller clay	1, 340	. 2
Pond Creek silt loam, 0 to 1 percent slopes	71, 560	12. 9
Pond Creek silt loam, 1 to 3 percent slopes	20, 695	3. 7
Port silt loam	7, 345	1. 3
Pratt loamy fine sand, 0 to 3 percent slopes	10, 435	1. 9
Pratt loamy fine sand, 3 to 8 percent slopes	13, 555	2. 5
Quinland-Woodward complex, 3 to 5 percent slopes	9, 405	1. 7
Quinlan-Woodward complex, 5 to 30 percent slopes	16, 370	3. 0
Reinach very fine sandy loam	15, 780	2. 8
Renfrow silt loam, 0 to 2 percent slopes	5, 430	1. 0
Ruella loam, 0 to 2 percent slopes	6, 515	1. 2
Salorthids	17, 555	3. 1
Shellabarger fine sandy loam, 1 to 3 percent slopes	12, 025	2. 2
Tabler silty clay loam, 0 to 1 percent slopes	3, 285	. 6
Tivoli fine sand	9, 475	1. 7
Woodward-Quinlan complex, 1 to 3 percent slopes	10, 730	1. 9
Yahola soils	17, 345	3. 1
Yahola and Port soils, frequently flooded	7, 400	1. 3
Total	554, 880	100. 0

grain sorghum. Some areas, however, are used as native range, tame pasture, or wildlife habitat.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. If a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Capability unit IIIs–2; Sandy Prairie range site; tame pasture suitability group 11A; Loamy Upland tree suitability group.

Albion sandy loam, 1 to 3 percent slopes (AbB).—This very gently sloping soil is on uplands. It has the profile described as representative of the Albion series.

Included with this soil in mapping were areas of Shellabarger, Grant, and Attica soils. About 5 percent of the total acreage in the mapping unit is Shellabarger soils, 3 percent is Grant soils, and 3 percent is Attica soils.

This Albion soil is used mainly for small grains and sorghum. Some areas are used as native range or tame pasture.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. If at seeding time the soil does not have an adequate cover of crop residue, runoff and water erosion can be reduced by constructing terraces and by farming on the contour. The terraces can be more widely spaced if adequate supporting practices are used than if such practices are lacking. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on this soil respond well to applications of a suitable fertilizer. Capability unit IIIe–5; Sandy Prairie range site; tame pasture suitability group 11A; Loamy Upland tree suitability group.

Albion sandy loam, 3 to 5 percent slopes (AbC).—This gently sloping soil is on uplands. In most places the profile is thinner than the one described as representative of the Albion series.

Included with this soil in mapping were areas of soils that have a similar profile but that are so eroded that part of the subsoil is mixed with the remaining material from the original surface layer. These eroded areas make up about 15 percent of the total acreage in the mapping unit. Other inclusions consist of small areas of Pratt and Shellabarger soils.

This Albion soil is used mainly for small grains and grain sorghum. About 80 percent of the acreage is used for these crops. The rest is used mainly as native range or tame pasture.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is allowed to remain on the soil surface

or is returned to the soil, applications of nitrogen fertilizer are needed. If at seeding time the soil does not have an adequate cover of crop residue, runoff and water erosion can be reduced by constructing terraces and by farming on the contour. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on this soil respond well to applications of a fertilizer high in content of phosphorus and potassium. Capability unit IVe-2; Sandy Prairie range site; tame pasture suitability group 11A; Loamy Upland tree suitability group.

Albion sandy loam, 5 to 15 percent slopes (AbE).—This soil is on uplands. It is sloping to moderately steep.

Included with this soil in mapping were areas of soils that have a similar profile but that have a lighter colored surface layer or have a combined surface layer and subsoil thickness of less than 20 inches. In these included areas, slopes are generally 15 to 25 percent. Other inclusions consist of areas of Attica and Grant soils. About 25 percent of the total acreage is included areas of soils that have a similar profile and have slopes of 15 to 25 percent, 12 percent is Attica soils, and 8 percent is Grant soils.

This Albion soil is not suited to crops that require cultivation. It is used as native range or tame pasture. Suitable management practices are discussed and names of grasses suitable for tame pasture are given in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit VIe-1; Sandy Prairie range site; tame pasture suitability group 11A; Loamy Upland tree suitability group.

Albion-Grant complex, 3 to 5 percent slopes (AgC).—This mapping unit consists of gently sloping soils on uplands. About 70 percent of the acreage is Albion soils, and 26 percent is Grant soils. The rest consists of about equal acreages of Pond Creek and Shellabarger soils that were included during mapping.

The Albion soils are on the crests and the upper parts of slopes. They have a profile similar to the one described as representative of the Albion series, except that the surface layer is loam in some places. The Grant soils are on side slopes and on foot slopes. They have a profile similar to the one described as representative of the Grant series, except that the surface layer is loam or very fine sandy loam in places.

Small grains are the principal crops, but grain sorghum is grown to some extent. Some areas are used for tame pasture, and a few areas are in native range.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. If at seeding time these soils do not have an adequate cover of crop residue, runoff and water erosion can be reduced by constructing terraces and by farming on the contour. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on these soils respond well to applications of a fertilizer high in content of phosphorus and potassium. Capability unit IVe-2; Albion part, Sandy Prairie range site and tame pasture suitability group IIA; Grant part, Loamy Prairie range site and tame pasture suitability group 8A; Loamy Upland tree suitability group.

Albion-Grant complex, 3 to 5 percent slopes, eroded (AgC2).—This mapping unit consists of gently sloping soils on uplands. In about 30 percent of the acreage, the plow layer is a mixture of material from the subsoil and from the remaining original surface layer. There are small rills and a few small gullies in most areas.

About 45 percent of the acreage is Albion soils, and 30 percent is Grant soils. The rest of the acreage consists of areas of soils, included during mapping, that have a profile similar to those of Albion or Grant soils but that have a thinner or lighter colored surface layer. Other inclusions consist of areas of Nash soils. About 15 percent of the total acreage in this mapping unit consists of areas of soils that have a profile similar to that of Albion soils; about 5 percent consists of areas of soils that have a profile similar to that of Grant soils; and about 5 percent consists of areas of Nash soils.

The Albion soils are on the crests and the upper parts of slopes. They have a profile similar to the one described as representative of the Albion series, except that the surface layer is loam in some places. The Grant soils are on side slopes and foot slopes. They have a profile similar to the one described as representative of the Grant series, except that the surface layer is loam or very fine sandy loam in places.

Small grains are the principal crops, but grain sorghum is grown to some extent. Some areas are used for tame pasture.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. If a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. To reduce runoff and water erosion, terraces are needed and farming should be done on the contour. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on these soils respond well to applications of a fertilizer high in content of phosphorus and potassium. Capability unit IVe-4; Albion part, Sandy Prairie range site and tame pasture suitability group 11A; Grant part, Loamy Prairie range site and tame pasture suitability group 8A; Loamy Upland tree suitability group.

Albion-Grant complex, 5 to 8 percent slopes, eroded (AgD2).—This mapping unit consists of sloping soils on uplands. In about 35 percent of the acreage, these soils are so eroded that the plow layer is a mixture of material from the subsoil and from the remaining original surface layer. In most areas there are many small rills and a few small gullies.

About 50 percent of the acreage is Albion soils, and 24 percent is Grant soils. About 22 percent consists of areas of soils, included during mapping, that have a profile similar to those of Albion or Grant soils but that have a thinner or lighter colored surface layer. The rest of the acreage consists of areas of Nash soils.

The Albion soils are on the crests and the upper parts of slopes. They have a profile similar to the one described as representative of the Albion series, except that the surface layer is loam in some places. The Grant soils are on side slopes and foot slopes. They have a profile similar to the one described as representative of the Grant series, except that the surface layer is loam or very fine sandy loam in places.

Small grains, principally wheat, are the main crops, but grain sorghum is grown to some extent. Some areas are used for tame pasture.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. Terraces installed to protect these soils from water erosion can be more widely spaced if adequate supporting practices are used than if such practices are lacking. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on these soils respond well to applications of a fertilizer high in content of phosphorus and potassium. Capability unit IVe-5; Albion part, Sandy Prairie range site and tame pasture group 11A; Grant part, Loamy Prairie range site and tame pasture group 8A; Loamy Upland tree suitability group.

Aline Series

The Aline series consists of nearly level through strongly sloping, somewhat excessively drained soils on uplands. These soils have formed in sandy sediment under a cover of tall and mid grasses and such scattered woody plants as sand plum, skunkbrush, and sumac.

In a representative profile, the surface layer is brown fine sand about 8 inches thick. The subsurface layer is light-brown fine sand about 26 inches thick. The subsoil, which is also light-brown fine sand, contains layers of reddish-yellow loamy fine sand one-fourth inch to 3 inches thick.

Permeability is rapid. Available water capacity is low to moderate.

Representative profile of Aline fine sand, 0 to 3 percent slopes, 950 feet east and 300 feet south of the northwest corner of sec. 22, T. 27 N., R. 9 W.:

A1—0 to 8 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) moist; weak, fine, granular structure; loose, very friable; slightly acid; gradual, wavy boundary.

A21—8 to 34 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; weak, very fine, granular structure; loose, very friable; slightly acid; clear, wavy boundary.

A22&B2t—34 to 72 inches, (A22 horizon) light-brown (7.5 YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose; contains bands, one-fourth inch to 3 inches thick and one-half inch to 5 inches apart, of reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist, that are the B2t horizon; material in the bands has weak, medium, subangular blocky structure; slightly hard, friable; some coatings and clay bridges between the sand grains in the bands; slightly acid.

Reaction throughout the profile is medium acid to neutral. The A1 horizon is brown, pale brown, yellowish brown, or grayish brown. The A2 horizon is light brown, brownish yellow, light yellowish brown, yellow, or reddish yellow. The B2t horizon consists of bands that are one-fourth inch to 3 inches thick and are between alternating layers of material that make up the A2 horizon.

Aline soils are associated with Dillwyn, Tivoli, and Goltry soils. They have a more developed profile than Dillwyn and Tivoli soils, and they lack the water table of the Dillwyn and Goltry soils. Aline soils have a profile similar to that of Pratt soils, but they have a thicker A horizon.

Aline fine sand, 0 to 3 percent slopes (AlB).—This sandy, nearly level and very gently sloping soil is on uplands. It has the profile described as representative of the Aline series.

Included with this soil in mapping were areas of Tivoli and Pratt soils. About 4 percent of the total acreage in this mapping unit is Tivoli soils, and about 4 percent is Pratt soils.

This Aline soil is used mainly for native range, but some areas are used to grow grain sorghum or wheat. About 85 percent of the acreage is in range.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. Properly fertilized weeping lovegrass is suitable for pasture and helps to control soil blowing. A complete fertilizer is needed for all crops grown on this soil. Capability unit IVs-1; Deep Sand range site; tame pasture suitability group 9A; Sandy tree suitability group.

Aline-Tivoli complex, 5 to 12 percent slopes (AnE).—This mapping unit consists of sloping or strongly sloping soils on complex dunes and in valleys. About 40 percent of the acreage is Aline fine sand, and about 40 percent is Tivoli fine sand. An additional 15 percent consists of areas of Pratt soils that were included during mapping, and 5 percent consists of Goltry soils.

The Aline soil is in valleys and on foot slopes below the dunes. The Tivoli soil is on the dunes.

Soils of this mapping unit are not suitable for cultivated crops. They are mainly in native range, but small areas are in tame pasture. Suitable management practices are discussed and names of grasses suitable for tame pasture are given in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit VIe-2; Deep Sand range site; tame pasture suitability group 9A; Very Sandy tree suitability group.

Attica Series

The Attica series consists of nearly level through gently sloping, well-drained soils on uplands. These soils formed in loamy sediment under a cover of tall and mid grasses.

In a representative profile, the surface layer is brown fine sandy loam about 16 inches thick. The subsoil is reddish-brown fine sandy loam that extends to a depth of about 44 inches. The underlying material is brown loam.

Permeability is moderately rapid. Available water capacity is high.

Representative profile of Attica fine sandy loam, 0 to 3 percent slopes, in a cultivated field, 1,850 feet east and 375 feet south of the northwest corner of sec. 33, T. 25 N., R. 12 W.:

A1—0 to 16 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, fine, granular structure; slightly hard, friable (the upper 9 inches has been plowed); slightly acid; gradual, smooth boundary.

B2t—16 to 34 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse, granular; slightly hard, friable; clay bridges between the sand grains; slightly acid; gradual, smooth boundary.

B3—34 to 44 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, coarse, prismatic structure; slightly hard, very friable; neutral; granular, smooth boundary.

IIA1b—44 to 65 inches brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, medium, granular structure; hard, friable; moderately alkaline; noncalcareous.

The A horizon is brown or dark-brown loamy fine sand or fine sandy loam that is slightly acid or neutral in reaction. The B2t horizon is strong-brown, brown, or reddish-brown fine sandy loam, loam, or sandy loam that is also slightly acid or neutral in reaction. In places the B2t horizon contains weak bands of more clayey or of less clayey material. The IIA1b horizon is brown or dark-brown loam or silt loam that is neutral to moderately alkaline in reaction. In some areas the profile contains a C horizon instead of a IIA1b horizon. In those places the C horizon is strong-brown, reddish-brown, or reddish-yellow fine sandy loam or loamy fine sand.

Attica soils are associated with Crisfield, Reinach, Carwile, Grant, Pond Creek, Shellabarger, and Ruella soils. They differ from Crisfield and Reinach soils in having a developed textural profile, and they have less clay in their B horizon than Carwile, Grant, Point Creek, and Shellabarger soils. Attica soils have a more developed profile than Ruella soils. Their profile is similar to those of Albion and Pratt soils, but they lack the gravel that is typical in the C horizon of Albion soils. They have a more clayey B horizon than Pratt soils.

Attica loamy fine sand, 0 to 3 percent slopes (AsB).—This nearly level and very gently sloping soil is on uplands. The profile is similar to the one described as representative of the Attica series, except that the surface layer is loamy fine sand.

Included with this soil in mapping were areas of Crisfield and Pratt soils. About 5 percent of the total acreage in this mapping unit consists of areas of Crisfield soils, and about 2 percent consists of areas of Pratt soils.

This Attica soil is used mainly for small grains, grain sorghum, alfalfa, tame pasture and vetch. About 80 percent of the acreage is used for these crops and the rest is in native range.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. Properly fertilized weeping lovegrass, used for pasture, grows well on this soil and effectively controls soil blowing and water erosion. Crops respond well to applications of a complete fertilizer. Proper fertilization is helpful in producing the crop residue needed to control soil blowing. Capability unit IIIe-7; Deep Sand range site; tame pasture suitability group 9A; Sandy tree suitability group.

Attica fine sandy loam, 0 to 3 percent slopes (AtB).—This nearly level and very gently sloping soil is on uplands (fig. 2). It has the profile described as representative of the Attica series.

Included with this soil in mapping were areas of Shellabarger and Pond Creek soils. About 10 percent of the total acreage in this mapping unit is Shellabarger soils, and 5 percent is Pond Creek soils.

About 85 percent of the total acreage of this Attica soil is used for small grains, principally wheat. Other small acreages are used for grain sorghum, alfalfa, and tame pasture, and some areas are in native range.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown respond well to applications of a complete fertilizer. Capability unit IIe-3; Sandy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Attica fine sandy loam, 3 to 5 percent slopes (AtC).—This gently sloping soil is on uplands. The profile is similar to the one described as representative of the Attica series, except that the surface layer is thinner and the underlying material is coarser textured.

Included with this soil in mapping were areas of a soil that has a profile similar to that of Shellabarger soils but that is so eroded that most of the original surface layer has been removed. About 5 percent of the total acreage of this mapping unit consists of areas of this eroded soil.

This Attica soil is used mainly for small grains and grain sorghum. It is also suitable for native range and for tame pasture.

Controlling soil blowing, providing protection from water erosion, and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is allowed to remain on the soil surface or is returned to the soil, applications of nitrogen fertilizer are needed. If at seeding time the soil does not have an adequate cover of crop residue, terraces are needed. The terraces can be more widely spaced if adequate supporting practices are used than if such practices are lacking. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Crops grown on this soil respond well to applications of a suitable fertilizer. Capability unit IIIe-5; Sandy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Brewer Series

In the Brewer series are nearly level, moderately well drained soils on terraces. These soils formed in loamy

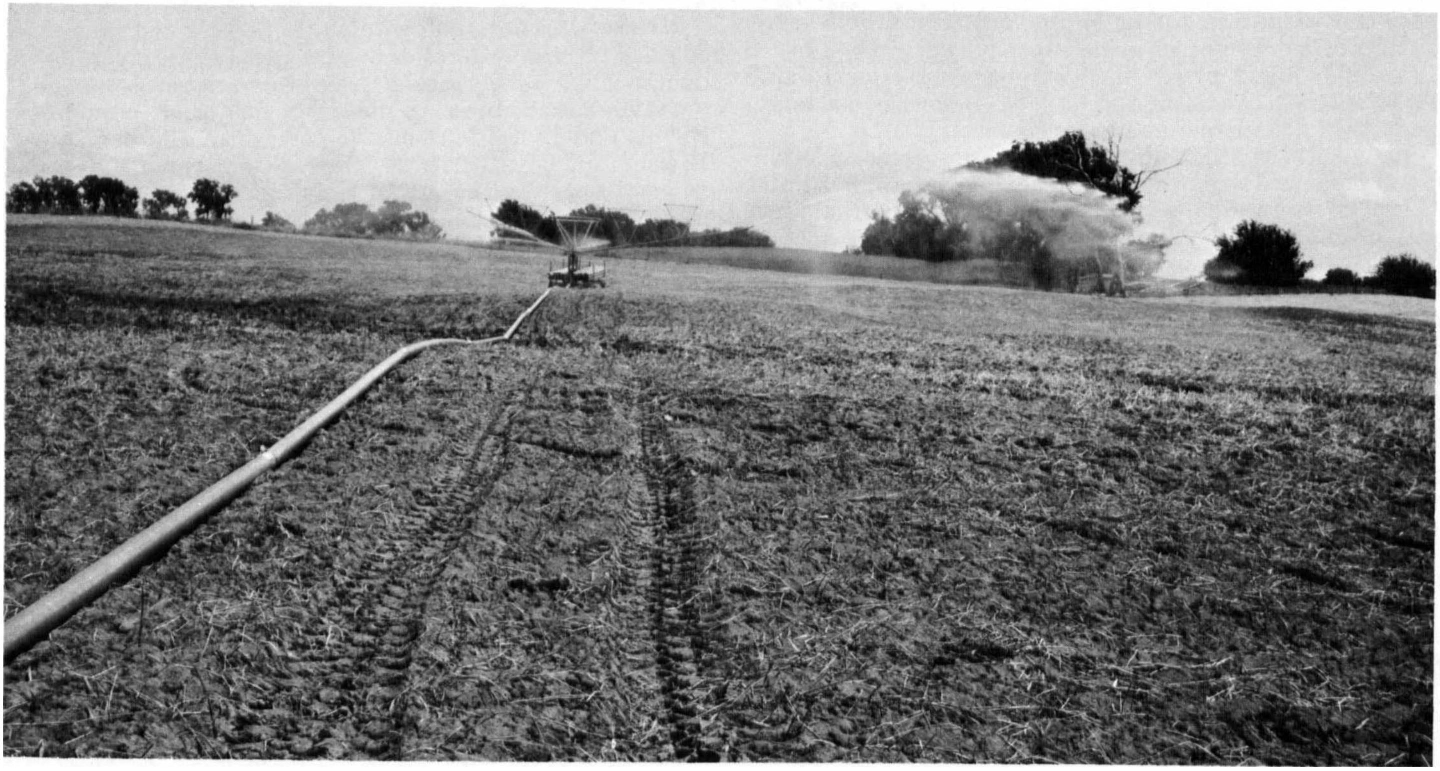

Figure 2.—**Irrigation on Attica fine sandy loam, 0 to 3 percent slopes.**

and clayey sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile, the surface layer is grayish-brown silt loam about 9 inches thick. Just below the surface layer is a layer of dark grayish-brown silt loam about 11 inches thick. The upper part of the subsoil extends to a depth of about 42 inches and is dark-brown silty clay loam. The lower part of the subsoil extends to a depth of about 52 inches and is reddish-brown silty clay loam mottled with gray. The underlying material is reddish-brown silty clay loam mottled with strong brown and gray.

These soils are free of salts to a depth of 40 inches. In places below that depth, they are also free of salts. In other areas they are slightly affected, moderately affected, or strongly affected by salinity below a depth of 40 inches. Permeability is slow. Available water capacity is high.

Representative profile of Brewer silt loam, 825 feet west and 160 feet north of the southeast corner of sec. 27, T. 27 N., R. 11 W.:

Ap—0 to 9 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; slightly hard, friable; slightly acid; clear, smooth boundary.

A1—9 to 20 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

B2t—20 to 42 inches, dark-brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate, medium, blocky structure; extremely hard, extremely firm; continuous clay films on ped surfaces; few medium concretions of calcium carbonate in lower part of horizon; mildly alkaline and noncalcareous to a depth of 32 inches; moderately alkaline and calcareous below a depth of 32 inches; gradual, smooth boundary.

B3—42 to 52 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; few, fine, distinct, gray mottles; weak, coarse, blocky structure; very hard, firm; few black concretions; few very fine spots and streaks of carbonates and gypsum; calcareous; moderately alkaline; diffuse, smooth boundary.

C—52 to 75 inches, reddish-brown (5YR 1/4) silty clay loam, reddish brown (5YR 4/4) moist; many, fine, distinct, strong-brown mottles and few, medium, distinct, gray mottles; massive; very hard, firm; weak stratification: few black concretions and few spots, threads, and concretions of calcium carbonate and gypsum; moderately affected by salinity; calcareous; moderately alkaline.

Thickness of the solum ranges from 50 to more than 70 inches. The A horizon is brown, dark brown, grayish brown, or dark grayish brown and is slightly acid or neutral in reaction. The B2t horizon is brown, dark brown, very dark grayish brown, or dark grayish brown. It consists of mildly alkaline or moderately alkaline clay loam or silty clay loam that has a content of clay of 35 to 40 percent. The B3 horizon is brown, dark brown, or reddish brown. It is underlain by a C horizon that is yellowish red, reddish brown, or grayish brown and that is mottled with brown, strong brown, and gray.

Brewer soils are associated with Dale, Port, Pond Creek, and Drummond soils. They have more clay in the upper part of their B horizon than Dale, Port, and Pond Creek soils, and they have a thicker A horizon and are less saline in the upper part of the profile than Drummond soils. The profile of Brewer soils is similar to those of McLain and Tabler soils, but Brewer soils have a less reddish B horizon than McLain soils, and they have a thicker A horizon than Tabler soils.

Brewer silt loam (Br).—This is a nearly level soil on terraces. It is rarely flooded but is subject to flooding

for brief periods in spring and in fall. The profile is free of salts to a depth of 40 inches. It is only slightly affected by salinity or, in places, it is free of salts below a depth of 40 inches. The profile is the one described as representative of the Brewer series.

Included with this soil in mapping were areas of Drummond soils and areas of a soil that has a profile similar to that of Brewer soils but that has less clay in the upper part of the subsoil. About 2 percent of the total acreage in this mapping unit consists of Drummond soils, and about 10 percent consists of the soil that has a similar profile.

This Brewer soil is well suited to small grains, grain sorghum, and alfalfa, and it is used mainly for those crops. It is also suitable for tame pasture and for native range.

Maintaining desirable soil structure and fertility are the main concerns of soil management. Soil structure can be improved and soil fertility can be maintained by returning adequate crop residue to the soil each year and by applying the proper kinds and amounts of fertilizer. Periodically changing the depth of tillage and performing tillage at a time when the least compaction is likely to occur are practices that reduce the risk that a tillage pan will form. Capability unit I-1; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Brewer-Drummond complex (Bu).—This mapping unit consists of nearly level and very gently sloping soils in uneven areas on terraces. These soils are rarely flooded, but they are subject to flooding for brief periods in spring and in fall. About 70 percent of the acreage is Brewer silt loam, and 20 percent is Drummond soils. About 10 percent consists of a soil, included during mapping, that has a profile similar to that of Brewer soils, except that the upper part of the subsoil is less clayey.

The Brewer soil in this mapping unit occurs at a slightly higher elevation than the Drummond soils. It is in areas between slight depressions occupied by Drummond soils. The profile is similar to the one described as representative of the Brewer series. The surface layer and the subsoil are slightly thinner, however, and the soil material is moderately or strongly affected by salinity below a depth of 40 inches. The Drummond soils in most places have the profile described as representative of the Drummond series, but the surface layer is loam in some places. In the Drummond soils, a water table is at a depth of more than 50 inches.

Soils of this mapping unit are well suited to barley, tall wheatgrass, and alfalfa, which are crops that tolerate salt. About 70 percent of the acreage is used for alfalfa (fig. 3), small grains, and grain sorghum. An additional 20 percent is in native range, and about 10 percent is in bermudagrass and tall wheatgrass grown for pasture.

***Figure 3.*—Alfalfa grown for hay on soils of Brewer-Drummond complex. Some effects of moderate salinity can be seen in the foreground.**

Improving soil structure, reducing surface crusting, maintaining soil fertility, and overcoming limitations imposed by soil salinity are the main concerns of soil management. Returning an adequate amount of crop residue to the soils each year improves soil structure, helps to reduce surface crusting, and helps to maintain soil fertility. When wet, these soils should be protected from grazing and tillage that would cause excessive compaction. Applying the proper kinds and amounts of fertilizer helps to maintain soil fertility. Capability unit IIIs-1; Brewer part, Loamy Bottomland range site; Drummond part, Saline Subirrigated range site; tame pasture suitability group 2C; Saline tree suitability group.

Carwile Series

The Carwile series consists of nearly level, somewhat poorly drained soils in slight depressions in the uplands. These soils formed in loamy sediment under a cover of tall and mild grasses.

In a representative profile, the surface layer is dark grayish-brown loam about 12 inches thick. The upper part of the subsoil extends to a depth of about 38 inches and is grayish-brown clay loam mottled with yellowish red, dark yellowish brown, brown, and strong brown. The lower part of the subsoil extends to a depth of about 42 inches and is light-gray clay loam mottled with reddish yellow. Underlying the subsoil is reddish-yellow loam mottled with gray.

Permability is slow. Available water capacity is high.

Representative profile of Carwile loam in an area of Carwile-Attica complex, 0 to 3 percent slopes, 1,625 feet south and 230 feet east of the northwest corner of sec. 36, T. 24 N., R. 11 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; hard, friable; slightly acid; abrupt, smooth boundary.

A1—8 to 12 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

B1—12 to 16 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; common, fine, distinct, yellowish-red mottles and common, fine, faint, dark yellowish-brown mottles; weak, medium, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.

B2t—16 to 38 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10 YR 4/2) moist; common, fine, faint and distinct, brown, strong-brown, and yellowish-red mottles; moderate, medium, subangular blocky structure; extremely hard, very firm; continuous clay films on ped surfaces; neutral; gradual, smooth boundary.

B3—38 to 42 inches, light-gray (10YR 6/1) clay loam, dark grayish brown (10YR 4/2) moist; few, fine, distinct, reddish-yellow mottles; weak, coarse, blocky structure; very hard, firm; few fine concretions of calcium carbonate and many soft powders of carbonates; calcareous; moderately alkaline; clear, smooth boundary.

C—42 to 60 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; common, medium, distinct, gray (10YR 5/1) mottles; massive; very hard, firm; common fine and medium concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is very dark brown, dark brown, dark grayish brown, very dark grayish-brown, or very dark gray loam to fine sandy loam. Reaction of the A horizon is medium acid to neutral. Color and reaction of the B1 horizon are similar to those of the A horizon, except that the B1 horizon is grayish brown in many places. The B2t horizon is dark grayish-brown, grayish-brown, dark-brown, gray, very dark gray, or very dark grayish-brown clay loam, clay, or sandy clay that is mottled with reddish or yellowish colors or with brown, strong brown, and gray. Reaction of the B2t horizon is neutral to moderately alkaline. The B3 horizon is dark grayish-brown, grayish-brown, dark yellowish-brown, yellowish-brown, dark-brown, brown, strong-brown, light-gray, or gray clay loam, sandy clay loam, or sandy clay. Reaction of the B3 horizon is mildly alkaline or moderately alkaline. The C horizon is reddish-yellow, yellowish-red, strong-brown, dark-brown, or yellowish-brown fine sandy loam or loam that is mottled with red, brown, yellow, or gray.

Carwile soils are associated with Attica, Pratt, and Drummond soils. They have more clay in the upper part of their B horizon than do Attica and Pratt soils. Carwile soils are not saline like Drummond soils.

Carwile-Attica complex, 0 to 3 percent slopes (CaB).—Soils of this mapping units are on uplands. About 35 percent of the acreage is Carwile soils, and 30 percent is Attica soils. An additional 25 percent consists of areas of soils, included during mapping, that have a profile similar to that of Carwile soils but that have a less clayey subsoil. About 10 percent consists of included areas of soils that have a profile similar to that of Attica soils but that have gray mottles at a depth of less than 40 inches.

The Carwile soils of this mapping unit are nearly level and occur in slightly concave areas of uplands. They are at a slightly lower elevation than the Attica soils. In most places the profile is the one described as representative of the Carwile series, but the surface layer is fine sandy loam in some areas. For short periods in winter and in spring, Carwile soils have a water table at a depth of 0 to 12 inches.

The Attica soils are generally at an elevation 1 to 5 feet above the areas occupied by Carwile soils, and they are more sandy than Carwile soils. Their profile is similar to the one described as representative of the Attica series, except that the surface layer is loamy fine sand in places.

Small grains, principally wheat, are the main crops grown on the soils of this mapping unit. Small acreages are also used for alfalfa, barley, grain sorghum, and tame pasture.

The main concerns of soil management are controlling soil blowing, providing protection from water erosion, maintaining soil fertility, and providing surface drainage. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. Properly fertilized weeping lovegrass and bermudagrass grow well on these soils and effectively control soil blowing and water erosion. Crops grown on these soils respond well to applications of a complete fertilizer. Capability unit IIw-1; Sandy Praire range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Crisfield Series

The Crisfield series consists of nearly level, well-drained soils on terraces. These soils formed in loamy sedi-

ment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile, the surface layer is brown fine sandy loam about 14 inches thick. The subsoil is reddish-brown fine sandy loam that extends to a depth of about 44 inches. The underlying material is yellowish-red very fine sandy loam.

Permeability is moderately rapid. Available water capacity is high.

Representative profile of Crisfield fine sandy loam, 2,240 feet west and 2,200 feet south of the northeast corner of sec. 13, T. 28 N., R. 10 W.:

Ap—0 to 8 inches, brown (7.5YR 4/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, medium, granular structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A1—8 to 14 inches, brown (7.5YR 4/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, coarse, granular structure; slightly hard, very friable; neutral; gradual, smooth boundary.

B2—14 to 44 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, coarse, prismatic structure; slightly hard, very friable; neutral; gradual, smooth boundary.

C—44 to 75 inches, yellowish-red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; common strata of sandy loam, 1 to 3 inches thick, below a depth of 54 inches; few threads and spots of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown or dark brown and is slightly acid or neutral in reaction. The B2 horizon is reddish-brown or brown fine sandy loam or loam that also is slightly acid or neutral in reaction. The C horizon is yellowish-red, reddish-brown, or reddish-yellow fine sandy loam, loam, or very fine sandy loam that contains thin layers of coarser textured material in most places. The C horizon is mildly alkaline or moderately alkaline.

Crisfield soils are associated with Yahola, Albion, and Attica soils. They differ from Yahola soils in that they are not calcareous above a depth of 36 inches. Crisfield soils have a profile that is less well developed than that of Albion and Attica soils.

Crisfield fine sandy loam (Cr).—This is a nearly level soil on terraces. It is rarely flooded but is subject to flooding for brief periods in spring and in fall.

Included with this soil in mapping were areas of soils that have a profile similar to that of this Crisfield soil but that have a lighter colored surface layer. Also included were areas of Yahola soils. About 10 percent of the total acreage in this mapping unit consists of included areas of soils that have a similar profile, and about 15 percent is Yahola soils.

This Crisfield soil is well suited to wheat, barley, alfalfa, grain sorghum, and grasses grown for tame pasture. It is used mainly for those crops.

Controlling soil blowing and maintaining desirable soil structure and fertility are the main concerns of soil management. Soil blowing can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. Properly fertilized weeping lovegrass, used for pasture, effectively controls soil blowing and water erosion, and it also provides good grazing for livestock. Crops grown on this soil respond well to applications of a complete fertilizer. Capability unit I-3; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Dale Series

Nearly level to sloping, well-drained soils on terraces are in the Dale series. These soils formed in loamy sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile (fig. 4), the surface layer is brown silt loam about 8 inches thick. Just below the surface layer is a layer of brown silt loam that is about 14 inches thick. The subsoil, also of brown silt loam, extends to a depth of about 35 inches. The underlying material is yellowish-red silt loam.

These soils are free of salts to a depth of less than 40 inches. In some places they are also free of salts below

Figure 4.—Profile of Dale silt loam.

a depth of 40 inches. In others they are slightly, moderately, or strongly affected by salinity below a depth of 40 inches. Permeability is moderate. Available water capacity is high.

Representative profile of Dale silt loam, 0 to 1 percent slopes, 1,900 feet east and 140 feet south of the northwest corner of sec. 35, T. 26 N., R. 11 W.:

Ap—0 to 8 inches, brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

A1—8 to 22 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, granular; hard, firm; numerous worm casts; neutral; gradual, smooth boundary.

B2—22 to 35 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, granular; hard, friable; few small concretions of calcium carbonate below a depth of 30 inches; mildly alkaline; gradual, smooth boundary.

C—35 to 64 inches, yellowish-red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; a few thin layers of reddish-brown (5YR 4/4) silt loam; few small concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown, dark-brown, grayish-brown, or dark grayish-brown silt loam or silty clay loam. Reaction of the A horizon is neutral to moderately alkaline. The B2 horizon is brown, reddish-brown, or dark-brown silt loam or silty clay loam. It is mildly alkaline or moderately alkaline and is calcareous at a depth of 20 to 40 inches. The C horizon is brown, reddish-brown, or yellowish-red silt loam or silty clay loam.

Dale soils are associated with Reinach, Brewer, and McLain soils. They have more clay in their B horizon than Reinach soils, and they have less clay in the upper part of their B horizon than Brewer and McLain soils. Dale soils have a profile similar to those of Pond Creek and Port soils. They have a less well developed profile, however, than Pond Creek soils. The content of organic matter in their profile decreases gradually with increasing depth, instead of irregularly like that in the Port soils.

Dale silt loam, 0 to 1 percent slopes (DaA).—This nearly level soil is on terraces. In some places it is subject to flooding for brief periods in spring and in fall. Flooding rarely occurs, however, and some areas are never flooded. This soil is free of salts to depths below 40 inches. The profile is the one described as representative of the Dale series.

Included with this soil in mapping were areas of Brewer and of Pond Creek soils. Also included were areas of soils that have a similar profile but that have a surface layer less than 20 inches thick or are slightly affected by salinity below a depth of 40 inches. About 2 percent of the total acreage in this mapping unit consists of Brewer soils, 5 percent is Pond Creek soils, and 15 percent is soils that have a similar profile.

This Dale soil is well suited to small grains, sorghum, alfalfa, and many other crops, and it can also be used for tame pasture or native range. The principal crops are wheat, barley, alfalfa, and grain sorghum.

Maintaining desirable soil structure and fertility are the main concerns of soil management. Periodically changing the depth of tillage, and performing tillage when the least compaction is likely to occur, are practices that protect the soil structure and reduce the risk that a tillage pan will form. High soil fertility can be maintained by returning an adequate amount of crop residue to the soil each year and by applying the proper kinds and amounts of needed fertilizer. Capability unit I-1; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Dale silt loam, saline (De).—This nearly level soil is on terraces. It has a profile similar to the one described as representative of the Dale series but is moderately or strongly affected by salinity below a depth of 40 inches. Flooding rarely occurs, but this soil is subject to flooding for brief periods in spring and in fall.

Included with this soil in mapping were areas of soils that have a profile similar to that of Dale soils but that are saline above a depth of 40 inches. Also included were areas of soils that have a profile similar to that of Reinach soils but that are slightly or moderately saline below a depth of 40 inches. About 20 percent of the total acreage in this mapping unit consists of areas of soils that have a profile similar to that of Reinach soils.

This Dale soil is well suited to barley, tall wheatgrass, and alfalfa, which are crops that tolerate salt. About 80 percent of the acreage is used for small grains, grain sorghum, and alfalfa, and small acreages are used to grow bermudagrass and tall wheatgrass for pasture. The rest of the acreage is in native range.

Improving soil structure, reducing surface crusting, maintaining soil fertility, and overcoming the limitations imposed by soil salinity are the main concerns of soil management. Soil structure can be improved and salts can be kept from concentrating in the surface layer by keeping a growing crop or an adequate cover of crop residue on the soil surface. This practice and also applying the proper kinds and amounts of needed fertilizer help to maintain soil fertility. When wet, this soil should be protected from grazing and tillage that would cause excessive soil compaction. Capability unit IIIs-1; Loamy Bottomland range site; tame pasture suitability group 2A; Saline tree suitability group.

Dale soils, 3 to 8 percent slopes (DlD).— These gently sloping and sloping soils are on the side slopes of terraces. Their profile is similar to the one described as representative of the Dale series, except that the surface layer is silty clay loam in places.

Included with these soils in mapping were areas of soils that have a profile similar to that of Dale soils, except that they have a dark-colored surface layer less than 20 inches thick. Also included were areas of Reinach very fine sandy loam. About 10 percent of the total acreage in this mapping unit consists of areas of soils that have a similar profile. About 30 percent consists of areas of Reinach very fine sandy loam.

These Dale soils are suited to small grains, grain sorghum, and alfalfa. They are also suited to native range plants and to grasses grown for tame pasture.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled and soil structure can be improved by keeping an adequate cover of crop residue on the soil surface at seeding time. Where a large amount of crop residue is left on the soil surface or is returned to the soils, applications of nitrogen fertilizer are needed. Applications of a fertilizer high in

content of phosphorus and potassium are also needed to help crops produce enough residue to protect them from erosion. Capability unit IIIe-6; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Dillwyn Series

The Dillwyn series consists of nearly level or very gently sloping, somewhat poorly drained soils on uplands. These soils formed in sandy sediment under a cover of tall grasses and scattered willow, cottonwood, and other hardwood trees.

In a representative profile, the surface layer is brown loamy fine sand about 8 inches thick. The next layer, also brown loamy fine sand, is about 22 inches thick. The underlying material is loamy fine sand that is pale brown mottled with light gray in the upper part and is light yellowish brown mottled with strong brown in the lower part.

Above the water table, permeability is rapid and available water capacity is moderate.

Representative profile of Dillwyn loamy fine sand in a cultivated field, 1.500 feet north and 750 feet west of the southeast corner of sec. 28, T. 27 N., R. 9 W.:

Ap—0 to 8 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak, fine, granular structure; soft, very friable; some roots; slightly acid; gradual, smooth boundary.

AC—8 to 30 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak, fine, granular structure; soft, friable; neutral; diffuse, smooth boundary.

C1—30 to 48 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; common, fine, faint, light-gray mottles; massive; soft, very friable; water table at a depth of 47 inches; mildly alkaline; gradual, smooth boundary.

C2—48 to 70 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; many, medium, distinct, strong-brown (7.5YR 4/6) mottles; massive; soft, friable; many pores; mildly alkaline.

The A horizon ranges from brown or dark brown to dark grayish brown and is neutral to mildly alkaline. In places the acid or neutral in reaction. The AC horizon is brown or grayish brown and is neutral to mildly alkaline. In places the AC horizon is mottled with yellow or brown. The C horizon is brown or pale brown to yellowish brown or light yellowish brown and is mottled with gray, light gray, brown, strong brown, or yellow. It is typically loamy fine sand, but below a depth of 40 inches, the texture ranges to fine sandy loam in some areas.

Dillwyn soils are associated with Aline, Goltry, and Pratt soils. They lack the textural development in their profile that is typical in the profiles of these associated soils. Their profile is similar to that of Tivoli soils, but unlike Tivoli soils, they have a water table at some depth between 15 and 60 inches.

Dillwyn loamy fine sand (Dm).—This is a nearly level or very gently sloping soil on uplands. In most places it is surrounded by areas of soils that are undulating to hummocky. Depth to the water table is about 15 inches during wet periods, but it is as much as 60 inches during dry periods.

Included with this soil in mapping were areas of soils that have a profile similar to that of Dillwyn soils but that are moderately alkaline and are calcareous. Also included were areas of soils that also have a profile similar to that of Dillwyn soils but that are gray at depths below 20 to 40 inches. About 30 percent of the total acreage in this mapping unit consists of areas of moderately alkaline and calcareous soils, and about 15 percent consists of areas of more grayish soils.

This Dillwyn soil is suited to small grains, alfalfa, sorghum, and bermudagrass. About 60 percent of the acreage is used for small grains, grain sorghum, and alfalfa. An additional 5 to 10 percent, in areas where plants receive beneficial moisture from the high water table, is in tame pasture. The rest of the acreage is in native range.

Controlling soil blowing and maintaining or improving soil fertility are the main concerns of soil management. An additional concern of management is protecting crops from the excess moisture that causes damage when the level of the water table rises during wet periods, though during normal or dry periods, the water table generally provides moisture that is beneficial to crops. Soil blowing can be controlled by keeping a growing crop or an adequate cover of crop residue on the soil surface throughout the year. Soil fertility can be maintained by applying a suitable fertilizer each year. Cool-season plants, if properly fertilized, are suitable for seeding in tame pastures where the water table, in most places, is at a depth of 25 to 35 inches. Capability unit IVw-1; Subirrigated range site; tame pasture suitability group 9C; Moist Sandy tree suitability group.

Dougherty Series

The Dougherty series consists of nearly level or very gently sloping, well-drained soils on uplands. These soils formed in loamy and sandy sediment. The vegetation was a cover of tall and mid grasses and scattered clumps of sand plum, sumac, skunkbrush, and other woody plants.

In a representative profile, the surface layer is pale-brown fine sand about 10 inches thick. The subsurface layer, also pale-brown fine sand, is about 14 inches thick. The upper part of the subsoil extends to a depth of about 46 inches and is yellowish-red sandy clay loam. The lower part of the subsoil extends to a depth of about 62 inches and is yellowish-red fine sandy loam. Light reddish-brown fine sand is the underlying material.

Permeability and available water capacity are moderate.

Representative profile of Dougherty fine sand, 0 to 3 percent slopes, in a cultivated field, 1,375 feet north and 200 feet east of the southwest corner of sec. 1, T. 28 N., R. 10 W.:

Ap—0 to 10 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; many fine roots; slightly acid; clear, smooth boundary.

A2—10 to 24 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; common fine roots; slightly acid; clear, wavy boundary.

B2t—24 to 46 inches, yellowish-red (5Y 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; hard, friable; dark reddish-brown (5YR 3/4) coatings on ped surfaces; patchy clay films on ped surfaces, slightly acid; gradual, smooth boundary.

B3—46 to 62 inches, yellowish-red (5YR 5/6) fine sandy loam; yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure; hard, friable; slightly acid; gradual, smooth boundary.

C—62 to 75 inches, light reddish-brown (5YR 6/4) fine sand, reddish brown (5YR 5/4) moist; massive; soft, very friable; contains thin layers of sandy loam; few pebbles 1/8 to 1/2 inch in diameter; slightly acid.

The A1 horizon in areas that are not cultivated is pale brown, brown, or light brown. The A2 horizon has the same colors as the A1 horizon. The B horizon is reddish brown, yellowish red, or reddish yellow and is fine sandy loam or sandy clay loam. The C horizon is light reddish brown, reddish yellow, or yellowish red and is fine sand or fine sandy loam. Reaction of the C horizon is slightly acid or neutral.

Dougherty soils are associated with Goltry and Pratt soils. They have more clay in their B horizon than those soils.

Dougherty fine sand, 0 to 3 percent slopes (DoB).—This is a sandy soil on uplands. It is nearly level or very gently sloping.

Included with this soil in mapping were areas of soils that have a profile similar to that of Dougherty soils but that have a combined surface layer and subsurface layer thickness of less than 20 inches. Also included were areas of Pratt soils. About 20 percent of the total acreage in this mapping unit consists of areas of soils that have a similar profile, and about 5 percent consists of areas of Pratt soils.

This Dougherty soil is suited to small grains, sorghum, and alfalfa, and it is also suitable for tame pasture and for native range. About 70 percent of the acreage is in native range, and 30 percent is in small grains and grain sorghum.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping a growing crop or a cover of crop residue on the soil surface throughout the year. Other practices that help to control soil blowing consist of using a deep-furrow drill and of seeding crops at right angles to the direction of prevailing winds. If properly fertilized, weeping lovegrass can be grown. Crops grown on this soil respond well to applications of a complete fertilizer. Management practices suitable for the areas used for range are discussed in the section "Use of the Soils for Range." Capability unit IVs-1; Deep Sand range site; tame pasture suitability group 9A; Sandy tree suitability group.

Drummond Series

The Drummond series consists of nearly level or very gently sloping, somewhat poorly drained, saline soils on terraces. These soils formed in calcareous, loamy and clayey sediment. The vegetation was salt-tolerant tall and mild grasses and scattered buttonbrush, baccharis, and willow trees.

In a representative profile, the surface layer is dark grayish-brown silt loam about 8 inches thick. The upper part of the subsoil extends to a depth of about 24 inches and is light brownish-gray silty clay loam mottled with light yellowish brown. The lower part extends to a depth of about 48 inches and is brown clay loam mottled with reddish brown and grayish brown. The underlying material is light brownish-gray clay loam that is mottled with strong brown and greenish gray and contains thin layers of sandy loam to silt loam.

Because of the salts in these soils, available water capacity is moderate or low. Permeability is very slow.

Representative profile of Drummond silt loam in an area of Brewer-Drummond complex, 1,600 feet west and 80 feet north of the southeast corner of sec. 35, T. 29 N., R. 10 W.:

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; massive dry, and weak, fine, granular structure moist; very hard, firm; the upper one-fourth inch of soil material is a vesicular crust; moderately affected by salinity; a few roots; pore space extremely limited; slightly acid; abrupt, wavy boundary.

B21t—8 to 24 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common, fine, distinct, light yellowish-brown mottles; moderate, medium, prismatic structure parting to moderate, very fine, blocky; extremely hard, firm; few fine roots; continuous clay films on surfaces of peds; many small pores; moderately affected by salinity; calcareous; moderately alkaline; clear, smooth boundary.

B22t—24 to 36 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; common, fine and medium, distinct, strong-brown (7.5YR 5/6) and grayish-brown (2.5YR 5/2) mottles; weak, coarse, prismatic structure; extremely hard, firm; continuous clay films on surfaces of peds; common medium concretions of calcium carbonate and gypsum crystals; few dark-brown rust spots; moderately affected by salinity; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—36 to 48 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist: common, fine and medium, faint, reddish-brown (5YR 5/4) mottles and few, fine and medium, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, prismatic structure; hard, firm; moderately affected by salinity; many concretions, soft masses, films, and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C—48 to 62 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; coarse strong-brown (7.5YR 5/6) and greenish-gray (5GY 6/1) mottles; massive; hard, firm; contains thin layers of sandy loam to silt loam; moderately affected by salinity; few fine pebbles; common coarse concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown, dark-brown, yellowish-brown, dark yellowish-brown, dark grayish-brown, or very dark grayish-brown silt loam, loam, or fine sandy loam. It is slightly acid to mildly alkaline and is moderately or strongly saline. The B2t horizon is light brownish-gray, brown, dark yellowish-brown, yellowish-brown, grayish-brown, or light grayish-brown silty clay loam, clay loam, or clay that is mottled, in most places, with brownish, yellowish, grayish, or reddish colors. The B2t horizon is mildly alkaline or moderately alkaline and is moderately or strongly saline. It contains common clusters of fine to coarse gypsum and other salts. The B3ca horizon is brown, reddish-brown, yellowish-red, light brownish gray, or very pale brown clay loam, silty clay loam, or clay mottled with brownish and grayish colors. The B3ca horizon is moderately or strongly saline and contains many fine to coarse concretions of calcium carbonate. The C horizon is light brownish-gray, brown, reddish-brown, yellowish-red, or very pale brown sandy loam through clay, and it is stratified. The C horizon is mottled with brownish and grayish colors. It is moderately or strongly saline.

Drummond soils are associated with Brewer, Carwile, Albion, and Pratt soils and with Salorthids. They have a thinner A horizon and are more saline in the upper part of the B horizon than Brewer and Carwile soils, and they are more saline and have a more clayey B horizon than Albion and Pratt soils. Drummond soils have more textural profile development and have a smaller content of salts than Salorthids.

Drummond soils, 0 to 3 percent slopes (DrB).—These nearly level or very gently sloping soils are on terraces. In some places the profile is the one described as repre-

sentative of the Drummond series. In other places the profile is similar to the one described as representative, except that the surface layer is loam or fine sandy loam. Flooding rarely occurs, but these soils are subject to flooding for brief periods in spring and in fall. The water table is at a depth of 24 to 120 inches for short periods in winter and in spring.

Included with these soils in mapping were areas of soils that have a profile similar to that of Drummond soils but that have a less clayey subsoil. About 15 percent of the total acreage in this mapping unit consists of these included soils.

Because of their high content of salts, these Drummond soils are not suited to cultivated crops. They can be used for native range or can be seeded to salt-tolerant grasses and used for tame pasture. These soils are used mainly for native range, but some areas are in tame pasture. Tall wheatgrass, tall fescue, and bermudagrass are suitable plants for tame pasture, but establishing a stand of bermudagrass is difficult because of the high content of salts. Fertilizer is needed for tame pasture.

Avoiding soil compaction, reducing crusting of the surface layer, maintaining adequate soil fertility, and overcoming the limitations imposed by soil salinity are the main concerns of soil management. Management practices suitable for the areas in range or tame pasture are discussed in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit Vs-1; Saline Subirrigated range site; tame pasture suitability group 2C; Saline tree suitability group.

Drummond-Pratt complex, 0 to 3 percent slopes (DtB).—Soils that are nearly level or very gently sloping are in this mapping unit. About 70 percent of the acreage consists of Drummond soils, and 25 percent, of Pratt soils. The rest consists of areas of soils, included during mapping, that have a profile similar to that of Drummond soils but that have a surface layer of loamy fine sand.

The Drummond soils, in swales or depressions, have a profile similar to the one described as representative of the Drummond series, except that the surface layer is loam or fine sandy loam in some places. They have a water table at a depth of 24 to 120 inches for short periods in winter and spring. The Pratt soils are on ridges, mounds, or low dunes. They have a profile similar to the one described as representative of the Pratt series.

Soils of this mapping unit are not suited to cultivated crops, and they are mainly in native range or tame pasture. In general, they are suited to tall fescue, tall wheatgrass, bermudagrass, and other salt-tolerant grasses grown for tame pastures, but bermudagrass is difficult to establish on the Drummond soils. In some places areas of Drummond soils have been made more suitable for grasses by using a bulldozer to cover them with more sandy material from areas of Pratt soils or from the areas of included soils.

Avoiding soil compaction, reducing surface crusting, maintaining adequate soil fertility, and overcoming the limitations imposed by soil salinity are the main concerns of soil management. Where grasses are grown for tame pasture, suitable kinds and amounts of fertilizer are needed. For areas of these soils used for range or tame pasture, suitable management practices are discussed in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit Vs-2; Drummond part, Saline Subirrigated range site and tame pasture suitability group 2C; Pratt part, Deep Sand range site and tame pasture suitability group 9A; Saline tree suitability group.

Goltry Series

In the Goltry series are nearly level or very gently sloping, moderately well drained soils on uplands. These soils formed in sandy sediment under a cover of tall grasses and scattered willows, cottonwoods, and other hardwood trees.

In a representative profile, the surface layer is brown fine sand about 12 inches thick. The subsurface layer is light yellowish-brown fine sand about 18 inches thick. The upper part of the subsoil extends to a depth of about 50 inches and consists of very pale brown fine sand that contains thin (one-eighth inch to 3 inches thick) bands of strong-brown loamy fine sand that are one-half inch to 5 inches apart. The lower part of the subsoil extends to a depth of about 72 inches and consists of light-brown fine sand that contains thin (one-eighth inch to 3 inches thick) layers of strong-brown fine sandy loam that are 1 to 5 inches apart.

Permeability is rapid. Available water capacity is low.

Representative profile of Goltry fine sand, 0 to 3 percent slopes, in native range, 1,150 feet north and 821 feet east of the southwest corner of sec. 29, T. 28 N., R. 9 W.:

A1—0 to 12 inches, brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; many roots; slightly acid; clear, wavy boundary.

A21—12 to 30 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; very weak, fine, granular structure; loose, very friable; many roots; slightly acid; clear, wavy boundary.

A22&B21t—30 to 50 inches, (A22 horizon) very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; common, fine, distinct, dark grayish-brown mottles; single grained; loose; contains bands, one-eighth inch to 3 inches thick and one-half inch to 5 inches apart of strong-brown (7.5YR 4/6) loamy fine sand, strong brown (7.5YR 4/6) moist, that are the B21t horizon; material in the bands is massive and has some coatings and clay bridges between the sand grains; slightly hard, friable; neutral; diffuse, wavy boundary.

A23&B22t—50 to 72 inches, (A23 horizon) light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; common, fine, faint, dark grayish-brown mottles; single grained; loose; contains bands, one-eighth inch to 3 inches thick and 1 inch to 5 inches apart, of strong-brown (7.5YR 5/6) fine sandy loam, strong brown (7.5YR 4/6) moist, that are the B22t horizon; material in the bands is massive and has coatings and clay bridges between sand grains; slightly hard, friable; moderately alkaline.

The A1 horizon is brown, light brown, grayish brown, light yellowish brown, or very pale brown and is slightly acid or neutral in reaction. The A2 horizon is brown, pale brown, very pale brown, light yellowish brown, or grayish brown and is slightly acid to moderately alkaline. The lower part of the A2 horizon is fine sand containing thin layers of loamy fine sand and fine sandy loam that are the B2t horizon. Below a depth of 30 inches, the A2 horizon is mottled with brownish or grayish colors. The B2t horizon is strong brown, yellowish red, or reddish yellow and is slightly acid to moderately alkaline.

Goltry soils are associated with Dougherty, Aline, Dillwyn, and Tivoli soils. They have a less clayey B horizon than Dougherty soils, and they differ from Aline, Dillwyn, and Tivoli soils in having a developed textural profile. Goltry soils have a profile similar to that of Pratt soils, but they have a thicker A horizon. In addition, they have a water table at a depth of 30 to 80 inches.

Goltry fine sand, 0 to 3 percent slopes (GoB).—This nearly level or very gently sloping soil is on uplands. It has a water table at a depth of about 30 inches during wet periods. During dry periods, the water table is at a depth of about 80 inches.

Included with this soil in mapping were areas of Dillwyn soils and areas of a soil that has a profile similar to that of Goltry soils but that has a surface layer of loamy fine sand. Other inclusions consist of small areas of soils that have a profile similar to that of Goltry soils but that are slightly or moderately saline at a depth of 4 to 7 feet. About 15 percent of the total acreage in the mapping unit is Dillwyn soils, and about 20 percent consists of soils that have a surface layer of loamy fine sand.

This Goltry soil is suited to small grains, grain sorghum, and plants grown for tame pasture. It is mainly in native range.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by keeping a growing crop or an adequate cover of crop residue on the soil surface throughout the year. Where small grains are grown, a deep-furrow drill or a semideep-furrow drill should be used to ridge the soil surface at right angles to the direction of prevailing winds. If properly fertilized, weeping lovegrass is suited to this soil. A fertilizer high in content of nitrogen and phosphorus is needed. Management practices suitable for the areas used for range are discussed in the section "Use of the Soils for Range." Capability unit IVs–1; Subirrigated range site; tame pasture suitability group 9C; Moist Sandy tree suitability group.

Gracemont Series

The Gracemont series consists of nearly level, somewhat poorly drained, moderately or strongly saline soils on flood plains. These soils formed in loamy and sandy sediment under a cover of salt-tolerant tall and mid grasses and scattered willow trees, buttonbush, and baccharis shrubs.

In a representative profile the surface layer is brown fine sandy loam about 18 inches thick. The upper part of the underlying material extends to a depth of about 28 inches and is reddish-brown fine sandy loam. The lower part of the underlying material extends to a depth of 60 inches or more and is light-brown fine sand mottled with grayish and brownish colors.

Permeability is moderately rapid above the water table. Available water capacity is low or moderate because of the soluble salts in the profile.

Representative profile in an area of Gracemont soils 1,250 feet east and 600 feet north of the southwest corner of sec. 5, T. 27 N., R. 10 W.:

A11—0 to 5 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5 YR 3/2) moist; weak, medium, granular structure; hard, friable; calcareous; moderately alkaline; moderately affected by salinity; gradual, smooth boundary.

A12—5 to 18 inches, brown (7.5YR 5/3) fine sandy loam, brown (7.5YR 4/3) moist; weak, medium, granular structure; hard, friable; calcareous; moderately alkaline; moderately affected by salinity; gradual, smooth boundary.

C1—18 to 28 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable; calcareous; moderately alkaline; moderately affected by salinity; clear, smooth boundary.

IIC2—28 to 60 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; few, coarse, distinct, dark grayish-brown (10YR 4/2) mottles; massive; loose; contains thin layers of more clayey material; few fine concretions of calcium carbonate; calcareous; moderately alkaline; moderately affected by salinity.

All of the horizons are moderately or strongly affected by salinity. The A horizon is brown, grayish-brown, or yellowish-brown fine sandy loam or loam. The C1 horizon is mainly reddish-brown, light yellowish-brown, brown, yellowish-red, light-brown, pink, or reddish-yellow fine sandy loam or loam, but in places it contains thin layers of more sandy or of more clayey material. The IIC2 horizon is light-brown, brown, reddish-brown, yellowish-red, reddish-yellow, pink, or light yellowish-brown, stratified fine sandy loam, fine sand, loamy sand, loam, or silt loam that is mottled with yellowish, brownish, or grayish colors.

Gracemont soils are associated with Salorthids and with Lincoln and Yahola soils. They have a lower content of salts than Salorthids and are generally less sandy than Lincoln soils at depths between 10 and 40 inches. Gracemont soils have a higher water table than Yahola soils.

Gracemont soils (Gp).—This mapping unit consists of nearly level soils on flood plains. These soils are frequently flooded. In most places they have the profile described as representative of the Gracemont series, but the surface layer is loam in some places. During most of the year, the water table is at a depth of about 40 inches. During wet periods, however, it is near the surface.

Included with these soils in mapping were areas of soils consisting of dark reddish-gray clay to a depth of about 25 inches but that gradually change to light-brown, stratified fine sandy loam below that depth. These included soils that make up about 10 percent of the total acreage in this mapping unit.

Because of their high content of salts, these Gracemont soils are not suited to cultivated crops but are in native range or tame pasture. They are suited to all wheatgrass, fescue, and bermudagrass grown for tame pasture.

The limitations of soil compaction, surface crusting, inadequate soil fertility, concentrated salts, and a seasonal high water table are all major concerns of soil management. Pastures should be established during the period when the concentration of salts is least likely to damage the plants. Where grasses are grown for tame pasture, fertilizer is needed. Management practices suitable for the areas used for native range and tame pasture are discussed in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit Vw–1; Saline Subirrigated range site; tame pasture suitability group 2C; Saline tree suitability group.

Grant Series

The Grant series consists of very gently sloping through strongly sloping, well-drained soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from sandstone, shale, or loamy sediment.

In a representative profile (fig. 5), the surface layer is brown silt loam about 16 inches thick. The upper part of the subsoil is reddish-brown silty clay loam that extends to a depth of about 22 inches. The middle part of the subsoil is yellowish-red silty clay loam that extends to a depth of about 36 inches. The lower part is yellowish-red silt loam that extends to a depth of about 52 inches. The underlying material is stratified. It consists mainly of yellowish-red silt loam, but it contains thin layers of dark reddish-brown gravelly loam.

Permeability is moderate. Available water capacity is high.

Representative profile of Grant silt loam, 1 to 3 percent slopes, in a cultivated field, 425 feet west and 175 feet north of the southeast corner of sec. 3, T. 23 N., R. 10 W.:

Ap—0 to 7 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; slightly acid; clear, smooth boundary.

A1—7 to 16 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

B1—16 to 22 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, subangular blocky structure; hard, friable; mildly alkaline; gradual, smooth boundary.

B2t—22 to 36 inches, yellowish-red (5YR 4/6) silty clay loam, yellowish red (5YR 3/6) moist; moderate, coarse, subangular blocky structure; hard, firm; nearly continuous clay films on ped surfaces; moderately alkaline; gradual, smooth boundary.

B3—36 to 52 inches, yellowish-red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure; hard, friable; few spots and threads of soft, powdery calcium carbonate below a depth of 45 inches; calcareous; moderately alkaline; diffuse, smooth boundary.

C—52 to 75 inches, yellowish-red (5YR 5/8) silt loam, yellowish red (5YR 4/6) moist; contains thin layers of dark reddish-brown gravelly loam; massive; hard, friable; many spots and threads of calcium carbonate; calcareous; moderately alkaline.

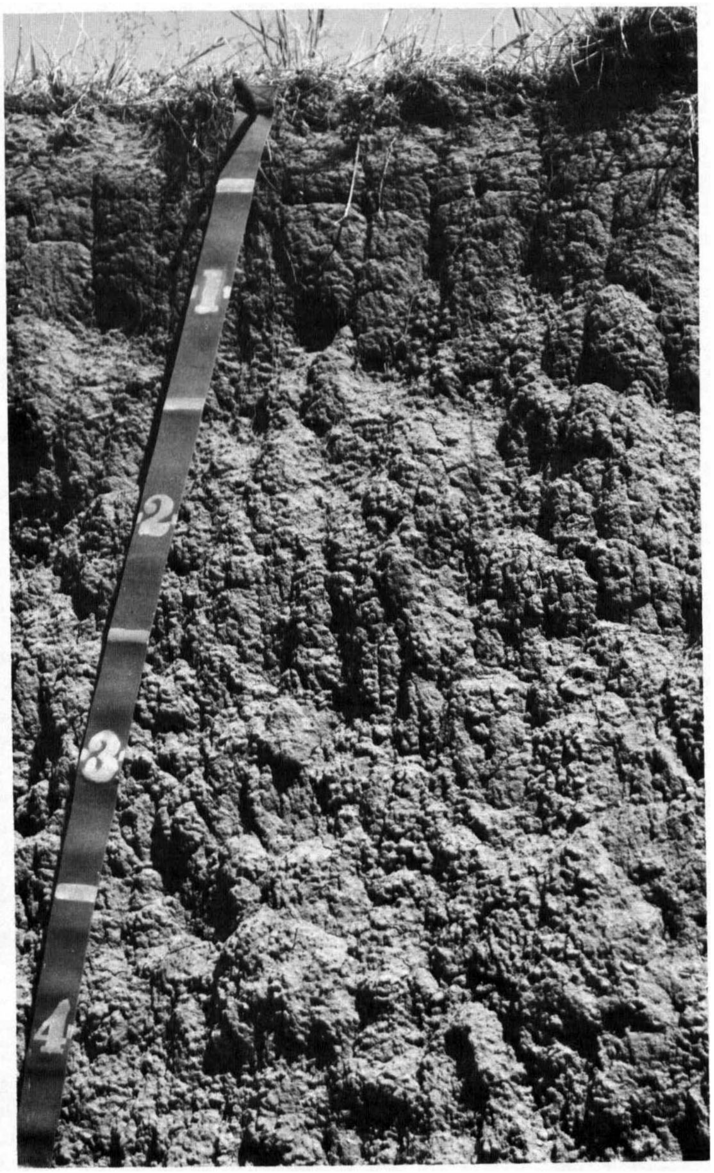

Figure 5.—Profile of Grant silt loam.

The A horizon is brown, dark-brown, or reddish-brown silt loam or loam that is slightly acid or neutral in reaction. It is underlain by a B1 horizon of brown, reddish-brown, or dark-brown silty clay loam or silt loam that is slightly acid to mildly alkaline. The B2 horizon is yellowish-red or reddish-brown silty clay loam or silt loam that is neutral to moderately alkaline in reaction. The B3 horizon is yellowish-red or reddish-brown silt loam or silty clay loam that is mildly alkaline or moderately alkaline. It is underlain by the C horizon of yellowish-red, reddish-yellow, or reddish-brown silt loam, sandstone, or shale. Depth to soft, powdery calcium carbonate ranges from 36 to more than 60 inches.

Grant soils are associated with Renfrow, Albion, Attica, Nash, Woodward, Pond Creek, Port, and Quinlan soils. They have less clay in the upper part of their B horizon than Albion and Attica soils. Grant soils have a better developed textural profile than Nash and Woodward soils. Their A horizon and the upper part of their solum is thicker than that of Quinlan soils. The profile of Grant soils is similar to that of Shellabarger soils, but their B horizon is less sandy.

Grant silt loam, 1 to 3 percent slopes (GrB).—This very gently sloping soil is on uplands. It has the profile described as representative of the Grant series.

Included with this soil in mapping were areas of Pond Creek, Albion, and Shellabarger soils. About 10 percent of the total acreage in this mapping unit is Pond Creek soils, 1 percent is Albion soils, and an additional 1 percent is Shellabarger soils.

This Grant soil is well suited to small grains and sorghum. It is also suited to alfalfa and can be used for tame pasture or native range. Most of the acreage is in wheat, barley, and grain sorghum.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled by keeping a cover of crop residue on the soil surface. Terraces are needed if at seeding time the soil surface does not have an adequate cover of crop residue. Applications of nitrogen fertilizer are also needed. Capability unit IIe-1; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Grant silt loam, 3 to 5 percent slopes (GrC).—This soil is on uplands. It is gently sloping.

Included with this soil in mapping were areas of Nash and Quinlan soils. About 5 percent of the total acreage

in this mapping unit is Nash soils, and about 2 percent is Quinlan soils.

This Grant soil is suited to wheat, barley, grain sorghum, alfalfa, and plants grown for tame pasture and native range. Most of the acreage is used for small grains, principally wheat.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Runoff and erosion can be reduced by installing terraces and by farming on the contour. The terraces can be more widely spaced if adequate conservation practices are used than if such practices are lacking. Maintaining an adequate cover of crop residue on the soil surface at seeding time also helps to control water erosion. Applications of nitrogen fertilizer are needed if a large amount of crop residue is returned to the soil or remains on the soil surface. Capability unit IIIe–2; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Grant silt loam, 3 to 5 percent slopes, eroded (GrC2).—This is a gently sloping soil on uplands. It is so eroded that in about 25 percent of the acreage the plow layer is a mixture of material from the original surface layer and the upper part of the subsoil. In most areas there are small rills and a few shallow gullies. The profile is similar to the one described as representative of the Grant series, except that the surface layer is thinner in most places.

Included with this soil in mapping were areas of soils that have a similar profile but that have lost all of their original surface layer through erosion. Also included were areas of Pond Creek and Nash soils. About 25 percent of the total acreage in this mapping unit consists of included areas of soils that have a similar profile but that are more eroded, 2 percent consists of Pond Creek soils, and 2 percent consists of Nash soils.

This Grant soil is better suited to small grains, sorghum, and other sown crops than to other kinds of crops. It is used mostly for small grains, principally wheat, but part of the acreage is used for barley, grain sorghum, and tame pasture.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Terraces can be used to control water erosion. They can be more widely spaced and still adequately control water erosion if the soil surface is protected by a cover of crop residue. Fertilizer is needed to maintain soil fertility. It also helps crops produce the residue needed to provide protection from erosion. Capability unit IIIe–3; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Grant-Nash complex, 3 to 8 percent slopes, eroded (GtD2).—This mapping unit consists of gently sloping or sloping soils on uplands. In about 30 percent of the acreage, these soils are eroded to the extent that the plow layer is a mixture of material from the remaining original surface layer and the subsoil. In most areas there are small rills and a few shallow gullies. About 40 percent of the acreage is Grant soils, and 15 percent is Nash soils. An additional 30 percent consists of areas of soils that were included during mapping but that are so eroded that they are outside the range of the Grant and the Nash series. Another 15 percent consists of included areas of Quinland, Woodward, and Pond Creek soils.

The Grant soils are on side slopes and on foot slopes, below areas of Nash soils. They have a profile similar to the one described as representative of the Grant series, except that their surface layer is thinner. The Nash soils are on the crests and on the upper parts of slopes. In most places they have the profile described as representative of the Nash series, but in some places their surface layer is loam.

Soils of this mapping unit are better suited to small grains than to other crops. They are used mainly for small grains, but small acreages are used for grain sorghum and tame pasture.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Terraces can be used to help control water erosion. In the less sloping areas, the terraces can be more widely spaced if a large amount of crop residue is kept on the soil surface than if such a cover is lacking. Fertilizer is needed. It not only maintains soil fertility, but it also helps crops produce enough residue to provide protection from erosion. Capability unit IVe–1; Loamy Prairie range site; Grant part, tame pasture suitability group 8A; Nash part, tame pasture suitability group 11A; Loamy Upland tree suitability group.

Grant-Port complex, 0 to 12 percent slopes (GuE).—In this mapping unit are nearly level to strongly sloping soils in narrow drainageways, on the side slopes of upland valleys, and on flood plains of narrow valley floors. About 35 percent of the acreage is Grant soils, and about 25 percent is Port soils. An additional 12 percent consists of areas of Yahola soils that were included during mapping; 10 percent consists of included areas of Attica soils; 10 percent consists of included areas of Quinlan soils; and 8 percent consists of included areas of Nash and Woodward soils.

The Grant soils, on side slopes in the uplands, are gently sloping to strongly sloping. Their profile is somewhat shallower than the one described as representative of the Grant series. Structure is also weaker, and the surface layer is loam in some places. The Port soils, on flood plains of valley floors, are nearly level. They have a profile similar to the one described as representative of the Port series, except that they are more stratified and the surface layer is loam or silty clay loam in some places.

Soils of this mapping unit are not suited to crops that require cultivation, but they are suited to bermudagrass and to native plants used for range. Most areas are used for range. Management practices suitable for areas of these soils used for range or tame pasture are discussed in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit VIe–3; Grant part, Loamy Prairie range site and tame pasture suitability group 8A; Port part, Loamy Bottomland range site and tame pasture suitability group 2A; Loamy Upland tree suitability group.

Lincoln Series

In the Lincoln series are nearly level or gently sloping, somewhat excessively drained soils on flood plains. These soils are frequently flooded for brief periods. They have formed in sandy sediment under a cover of tall and mid grasses and scattered cottonwood and willow trees.

In a representative profile, the surface layer is brown loamy fine sand about 8 inches thick. The underlying material is pink fine sand. It contains thin layers of fine sandy loam to clay loam.

These soils are free of salts or are only slightly affected by salts below a depth of 40 inches. Permeability is rapid. Available water capacity is low to moderate.

Representative profile in an area of Lincoln soils used for native range, 1,750 feet south and 250 feet west of the northeast corner of sec. 15, T. 27 N., R. 11 W.:

A1—0 to 8 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak, fine, granular structure; soft, very friable; thin layers of fine sand to heavy loam; calcareous; moderately alkaline; clear, smooth boundary.

C—8 to 65 inches, pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; thin layers of darker colored fine sandy loam to clay loam that decrease in number with increasing depth; calcareous; moderately alkaline.

The A horizon is mainly brown, reddish-brown, yellowish-brown, or light-brown loamy fine sand or fine sandy loam, but it contains thin layers of more sandy or of more clayey material. The C horizon is mainly pink, light reddish-brown, light-brown, reddish-yellow, pale brown, very pale brown, or light yellowish-brown fine sand or loamy fine sand, but it contains thin layers of sand through clay.

Lincoln soils are associated with Gracemont and Yahola soils. In most places they are more sandy at depths between 10 and 40 inches than these associated soils. They are less saline than Gracemont soils.

Lincoln soils (Ls).—These soils are nearly level or very gently sloping and are on flood plains. They are flooded for brief periods more than once each year. Except during periods of flooding, the water table is at a depth of 60 inches to about 96 inches. The profile is most places is the one described as representative of the Lincoln series, but the surface layer is fine sandy loam in some places.

Included with these soils in mapping were areas of Yahola soils and areas of soils that have a profile similar to that of Lincoln soils but that are flooded less than once each year. About 10 percent of the total acreage in this mapping unit consists of areas of Yahola soils, and 5 percent consists of areas of soils that have a similar profile.

Soils of this mapping unit are not suited to cultivated crops. They are suited to native range plants and to bermudagrass grown for tame pasture.

Protecting the soils from flooding, controlling soil blowing, increasing the available water capacity, and maintaining soil fertility are all concerns of soil management. Applications of a suitable fertilizer are needed each year for bermudagrass pasture to be successful. Brush control is also needed to prevent the invasion of woody plants. Management practices suitable for these soils are discussed in the sections "Use of the Soils for Range" and "Use of the Soils for Tame Pasture." Capability unit Vw-2; Sandy Bottomland range site; tame pasture suitability group 3A; Sandy tree suitability group.

McLain Series

The McLain series consists of nearly level, moderately well drained soils on terraces. These soils formed in calcareous clayey and loamy sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile, the surface layer is brown silt loam about 20 inches thick. The subsoil is reddish-brown silty clay loam that extends to a depth of about 52 inches. The underlying material is stratified and consists of reddish-brown silty clay loam and of yellowish-red silt loam.

Permeability is slow. Available water capacity is high.

Representative profile of McLain silt loam in a cultivated field, 1,875 feet north and 75 feet west of the southeast corner of sec. 11, T. 26 N., R. 11 W.:

Ap—0 to 8 inches, brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable; many fine pores; slightly acid; abrupt, smooth boundary.

A1—8 to 20 inches, brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable; many fine pores; neutral; gradual, smooth boundary.

B1—20 to 26 inches, reddish-brown (5YR 4/3) silty clay loam, dark-reddish brown (5YR 3/3) moist; weak, medium, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

B2t—26 to 40 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, bolcky structure; extremely hard, very firm; continuous clay films on surfaces of peds; calcareous below a depth of 35 inches; mildly alkaline; gradual, smooth boundary.

B3—40 to 52 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak, coarse, blocky structure; very hard, very firm; common fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C1—52 to 58 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; massive; very hard, very firm; common coarse concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2—58 to 75 inches, yellowish-red (5YR 5/6) silt loam and thin layers of fine sandy loam to silty clay loam; yellowish red (5YR 4/6) moist; massive; hard, friable; calcareous; moderately alkaline.

The A horizon is brown, dark brown, or reddish brown and is slightly acid or neutral in reaction. The B1 horizon has colors like those of the A horizon, and it is silty clay loam or clay loam. The B2t horizon is reddish-brown or dark reddish-brown silty clay loam or clay loam that is neutral to moderately alkaline in reaction. The B3 horizon is reddish-brown or yellowish-red silty clay loam or clay loam that is mildly alkaline or moderately alkaline. The C horizon is reddish-brown or yellowish-red clay loam, silt loam, or clay loam.

McLain soils are associated with Dale and Reinach soils, but they have more clay in the upper part of their B horizon than do those soils. Their profile is similar to those of Brewer and Pond Creek soils, but they have a more reddish B horizon than do Pond Creek soils.

McLain silt loam (Mc).—This soil is nearly level and is on terraces. It is rarely flooded but is subject to flooding for brief periods in spring and in fall.

Included with this soil in mapping were areas of a soil that has a profile similar to that of McLain soils but that has a surface layer of silty clay loam. Also included were areas of Brewer and of Dale soils. About 10 percent of the total acreage in this mapping unit consists of areas of a soil that has a surface layer of silty clay loam, 5 percent is Brewer soils, and 5 percent is Dale soils.

Among the many crops to which this McLain soil is well suited are small grains, sorghum, and alfalfa. This soil is also suited to grasses grown for tame pasture and to native plants suitable for range. The main crops are wheat, alfalfa, and grain sorghum.

Maintaining desirable soil structure and fertility are the main concerns of soil management. Soil structure can be improved and soil fertility can be maintained at a high level if adequate crop residue is returned to the soil each year and if supplemental applications of needed fertilizer are added. Periodically changing the depth of tillage, and performing tillage when the least compaction is likely to occur, reduce the risk that a tillage pan will form. Capability unit I-1; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Miller Series

Soils that are nearly level and that are moderately well drained are in the Miller series. These soils formed in calcareous, clayey sediment under a cover of tall and mid grasses and some hardwood trees.

In a representative profile, the surface layer is reddish-brown clay about 16 inches thick. The subsoil is also reddish-brown clay and extends to a depth of about 33 inches. The upper part of the underlying material is reddish-brown clay that extends to a depth of about 50 inches. The lower part is reddish-brown silt loam.

Permeability is very slow. Available water capacity is high.

Representative profile of Miller clay in a cultivated field, 1,000 feet north and 45 feet west of the southeast corner of sec. 15, T. 23 N., R. 12 W.:

Ap—0 to 4 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; strong, very fine, granular structure; hard, friable; calcareous in spots; moderately alkaline; abrupt, smooth boundary.

A1—4 to 16 inches, reddish-brown (5YR 5/3) clay, dark reddish brown (5YR 3/3) moist; weak, coarse, blocky and weak, fine, subangular blocky structure; extremely hard, very firm; shiny pressure surfaces on some peds; calcareous; moderately alkaline; gradual, smooth boundary.

B2—16 to 33 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak, coarse, subangular blocky structure; extremely hard, very firm; slickensides that do not intersect; shiny pressure surfaces on some peds; few soft masses of calcium carbonate below a depth of 20 inches; calcareous; moderately alkaline; gradual, smooth boundary.

C1—33 to 50 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; massive; extremely hard, very firm; slickensides that do not intersect; shiny pressure surfaces on some peds; few soft masses of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

IIC2—50 to 75 inches, reddish-brown (2.5YR 5/4) silt loam, reddish brown (2.5YR 4/4) moist; massive; hard, friable; stratified and contains a few thin lenses of fine sandy loam; calcareous; moderately alkaline.

The A horizon is reddish brown, dark reddish brown, or dark brown. The Ap horizon is neutral to moderately alkaline in reaction, but all horizons below the Ap are moderately alkaline and are calcareous. The B horizon is reddish-brown or dark reddish-brown clay, clay loam, or silty clay loam. The C1 horizon is yellowish-red or reddish-brown clay or silty clay loam. The IIC2 horizon is yellowish-red or reddish-brown silt loam, clay loam, clay, or silty clay loam.

Miller soils are associated with Port soils. They are more clayey than Port soils at depths between 10 and 40 inches.

Miller clay (Mr).—This is a nearly level soil on flood plains. It is occasionally flooded for brief periods in spring and in fall.

Included with this soil in mapping were areas of soils that have a profile similar to that of Miller soils but that are very dark grayish brown and are noncalcareous to a depth of more than 30 inches. About 10 percent of the total acreage in this mapping unit consists of these areas of soils that have a similar profile. Other inclusions consist of small areas of Port soils.

This Miller soil is better suited to small grains, especially wheat, than to other crops. It is not well suited to sorghum and alfalfa, although those crops are grown. The main crops are wheat and forage sorghum, but this soil can also be used for barley, grain sorghum, tame pasture, and native range.

This soil has a high content of clay. Therefore, if it is graded or tilled when wet, the soil structure is damaged. A crust also tends to form on the surface, and the crusting and the high content of clay reduce the intake of moisture.

Maintaining desirable soil structure and protecting this soil from flooding are the main concerns of soil management. Returning an adequate amount of crop residue to the soil each year helps to maintain desirable soil structure and fertility. Applications of nitrogen fertilizer are needed if a large amount of crop residue is returned to the soil. Capability unit IIIw-1; Heavy Bottomland range site; tame pasture suitability group 1A; Clayey tree suitability group.

Nash Series

The Nash series consists of gently sloping or sloping, well-drained soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from sandstone.

In a representative profile, the surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish-red silt loam that extends to a depth of about 30 inches. Beneath the subsoil is yellowish-red, weakly cemented, calcareous sandstone.

Permeability is moderate. Available water capacity is high or moderate.

Representative profile of Nash silt loam in an area of Grant-Nash complex, 3 to 8 percent slopes, eroded, 600 feet north and 150 feet east of the southwest corner of sec. 25, T. 26 N., R. 9 W.:

Ap—0 to 7 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, fine, granular structure; slightly hard, friable; many fine roots; mildly alkaline; clear, smooth boundary.

A1—7 to 12 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual, smooth boundary.

B2—12 to 30 inches, yellowish-red (5YR 4/6) silt loam, yellowish red (5YR 3/6) moist; weak, coarse, prismatic structure; slightly hard, friable; common fine roots; moderately alkaline; clear, smooth boundary.

C—30 to 40 inches, yellowish-red (5YR 5/6), weakly cemented, calcareous sandstone; thin white coatings in some seams.

The A horizon is brown, dark-brown, or reddish-brown silt loam or loam that is neutral or mildly alkaline in reaction. The B2 horizon is yellowish-red, reddish-brown, brown, or dark-brown silt loam or loam that is mildly alkaline or moderately alkaline.

Nash soils are associated with Grant, Pond Creek, Quinlan, and Woodward soils. They have a less developed textural pro-

file than Grant and Pond Creek soils, and they have a thicker solum than Quinlan soils. Unlike Woodward soils, Nash soils are noncalcareous.

Nash soils are mapped only in a complex with Grant soils.

Pond Creek Series

The Pond Creek series consists of nearly level or very gently sloping, well-drained soils on uplands. These soils formed under a cover of tall and mid grasses in calcareous, loamy sediment and in material weathered from silty sandstone or shale.

In a representative profile (fig. 6), the surface layer is brown silt loam about 17 inches thick. The subsoil is reddish-brown silty clay loam that extends to a depth of 58 inches. The underlying material is yellowish-red silty clay loam mottled with strong brown.

Permeability is moderately slow. Available water capacity is high.

Representative profile of Pond Creek silt loam, 0 to 1 percent slopes, in a cultivated field, 205 feet north and 100 feet east of the southwest corner of sec. 23, T. 24 N., R. 9 W.:

***Figure 6.*—Profile of Pond Creek silt loam.**

Ap—0 to 7 inches, brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/3) moist; weak, medium, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A1–7 to 17 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

B1—17 to 24 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; weak, coarse, subangular blocky structure; hard, friable; neutral; gradual, smooth boundary.

B21t—24 to 33 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate, coarse, subangular blocky structure; hard, firm; continuous clay films on surfaces of peds; neutral; gradual, smooth boundary.

B22t—33 to 48 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium, subangular blocky structure; extremely hard, very firm; continuous clay films on surfaces of peds; neutral; gradual, smooth boundary.

B3—48 to 58 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak, coarse, subangular blocky structure; hard, firm; few fine concretions of calcium carbonate; moderately alkaline; gradual, smooth boundary.

C—58 to 68 inches, yellowish-red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; few, fine, strong-brown mottles; massive; hard, firm; few fine concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown, dark brown, grayish brown, or dark grayish brown, and the B1 horizon is brown, dark brown, grayish brown, reddish brown, or dark grayish brown. The B2t horizon is reddish-brown, brown, dark-brown, yellowish-brown, dark yellowish-brown, grayish-brown, or dark grayish-brown silty clay loam or silt loam. Reaction of the A, B1, and B2t horizons is slightly acid or neutral. The B3 horizon is brown, dark-brown, yellowish-brown, dark yellowish-brown, or reddish-brown silt loam or silty clay loam that is neutral to moderately alkaline in reaction. Depth to soft, powdery secondary lime in the B3 horizon is more than 45 inches. The C horizon is brown, dark-brown, reddish-brown, yellowish-red, or red silty clay loam or silt loam that is mottled with brown, strong brown, or yellow. The C horizon is moderately alkaline and is calcareous.

Pond Creek soils are associated with Albion, Attica, Nash, Shellabarger, Grant, Renfrow, Ruella, Brewer, and Tabler soils. They have a more clayey B horizon than Albion, Attica, and Nash soils and they have a less sandy B horizon than Shellabarger soils. The dark colors of the A and B horizons of Pond Creek soils extend to a greater depth than they do in Nash, Shellabarger, Grant, Renfrow, and Ruella soils, and Pond Creek soils have a more strongly developed textural profile than Nash and Ruella soils. They have less clay in the upper part of their B horizon than Brewer, Renfrow, and Tabler soils. The profile of Pond Creek soils is similar to those of Dale, Port, and McLain soils, but Pond Creek soils have a more strongly developed textural profile than Dale and Port soils. They have less clay in the upper part of their B horizon than McLain soils.

Pond Creek silt loam, 0 to 1 percent slopes (PcA).—This nearly level soil is on uplands. It has the profile described as representative of the Pond Creek series.

Included with this soil in mapping were areas of Grant and Dale soils. About 5 percent of the total acreage in this mapping unit is Grant soils, and about 3 percent is Dale soils.

This Pond Creek soil is well suited to small grains and sorghums, and it is also suited to alfalfa, grasses grown for tame pasture, and native plants used for range. Small grains and grain sorghum are the main crops.

Maintaining desirable soil structure and fertility are the main concerns of soil management. Returning an

adequate amount of crop residue to the soil helps to maintain desirable soil structure and fertility. If a large amount of crop residue is returned to the soil, applications of nitrogen fertilizer are needed. Capability unit I–2; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Pond Creek silt loam, 1 to 3 percent slopes (PcB).—This gently sloping soil is on uplands. Except that the surface layer is about 3 inches thinner in most places, the profile is similar to the one described as representative of the Pond Creek series.

Included with this soil in mapping were areas of Grant soils. About 5 percent of the total acreage in this mapping unit consists of areas of Grant soils.

This Pond Creek soil is well suited to small grains and grain sorghum, and it is used mainly for those crops. It is also suited to alfalfa, to grasses grown for tame pasture, and to native plants used for range.

Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface. Where the soil does not have a cover of crop residue that is adequate for controlling water erosion, terraces are needed. Additional nitrogen fertilizer should be applied if crop residue is left on the soil surface or is returned to the soil. Capability unit IIe–1; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Port Series

The Port series consists of nearly level or very gently sloping, well-drained soils on flood plains. These soils formed in loamy sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile, the surface layer is brown silt loam about 26 inches thick. The subsoil is also brown silt loam and extends to a depth of about 44 inches. The underlying material is reddish-brown silt loam.

Port soils are free of salts or are only slightly affected by salinity below a depth of 40 inches. Permeability is moderate. Available water capacity is high.

Representative profile of Port silt loam in a cultivated field, 225 feet south and 100 feet west of the northeast corner of sec. 11, T. 25 N., R. 9 W.:

Ap—0 to 8 inches, brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate, medium and fine, granular structure; hard, friable; many worm casts; neutral; clear, smooth boundary.

A1—8 to 26 inches, brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak, medium, granular structure; hard, friable; neutral; gradual, smooth boundary.

B2—26 to 44 inches, brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/2) moist; weak, coarse, prismatic structure; hard, friable; neutral; gradual, smooth boundary.

C—44 to 75 inches, reddish-brown (5YR 5/4) silt loam, reddish brown (5 YR 4/4) moist; massive; hard, friable; few thin layers of yellowish-red (5YR 5/6) loam; few soft masses and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown, reddish-brown, dark-brown, or dark grayish-brown silt loam, loam, or silty clay loam that is neutral or mildly alkaline in reaction. The B2 horizon is brown, reddish-brown, or strong-brown loam, silt loam, or silty clay loam that is neutral to moderately alkaline. The C horizon has the same range in color and texture as the B horizon.

Port soils are associated with Brewer, Miller, Yahola, Reinach, and Grant soils. In most places the upper part of their B horizon contains less clay than that of Brewer and Miller soils. At depths between 10 and 40 inches, they contain more clay than Yahola and Reinach soils. The A and the B horizons of Port soils are darker and thicker than those of Grant soils. Port soils have a profile similar to those of Dale and Pond Creek soils. Unlike the Dale soils, however, they have an irregular decrease in content of organic matter with increasing depth. They have a less well developed textural profile than Pond Creek soils.

Port silt loam (Pr).—This is a nearly level soil on flood plains. It is occasionally flooded for brief periods in spring and in fall. The profile is the one described as representative of the Port series.

Included with this soil in mapping were areas of Rahola and Reinach soils that make up, respectively, 5 percent and 1 percent of the total acreage in this mapping unit. Also included were small areas of Port soils that have a surface layer of loam, clay loam, or silty clay loam.

This Port soil is used mainly for small grains, alfalfa, and grain sorghum. It is also suited to grasses grown for tame pasture and to native plants used for range.

Maintaining desirable soil structure and fertility and protecting this soil from flooding are the main concerns of soil management. Returning a moderate to large amount of crop residue to the soil each year and applying needed fertilizer maintains desirable soil structure and a high level of fertility. Periodically changing the depth of tillage, and tilling when the soil is not wet, are practices that reduce the risk that a tillage pan will form. A flood control project would reduce the risk of flooding. Capability unit IIw–2; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Pratt Series

The Pratt series consists of nearly level to sloping, well-drained soils on uplands. These soils formed in sandy sediment under a cover of tall and mid grasses and scattered, low-growing woody plants.

In a representative profile, the surface layer is pale-brown loamy fine sand about 9 inches thick. The subsoil is brown loamy fine sand that extends to a depth of about 42 inches. The underlying material is pale-brown loamy fine sand.

Permeability is rapid. Available water capacity is moderate.

Representative profile of Pratt loamy fine sand, 3 to 8 percent slopes, in a cultivated field, 1,000 feet south and 180 feet west of the northeast corner of sec. 19, T. 24, N., R. 12 W.:

Ap—0 to 9 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak, fine, granular structure; loose, very friable; slightly acid; clear, smooth boundary.

B2t—9 to 42 inches, brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) moist; weak, very coarse, prismatic structure parting to weak, fine, granular; slightly hard, very friable; sand grains are coated and bridged with clay; contains a few thin bands of darker colored material; slightly acid; diffuse smooth boundary.

C—42 to 75 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive; loose; slightly acid.

Reaction of all the horizons ranges from medium acid to neutral. The A horizon is pale brown, brown, dark yellowish brown, yellowish brown, or light yellowish brown. The B2t horizon is brown, light brown, light yellowish brown, yellowish brown, or reddish brown. The C horizon is light yellowish brown, pale brown, or light brown.

Pratt soils are associated with Albion, Carwile, Drummond, Dougherty, and Dillwyn soils. They have less clay in the B horizon than Albion, Carwile, Drummond, and Dougherty soils, and they have a more strongly developed textural profile than Dillwyn soils. The profile of Pratt soils is similar to those of Attica, Goltry, and Aline soils, but Pratt soils have less clay in the B horizon than Attica soils. They have a thinner A horizon than Goltry and Aline soils.

Pratt loamy fine sand, 0 to 3 percent slopes (PtB).—This nearly level or very gently sloping soil is on uplands. The profile is similar to the one described as representative of the Pratt series, except that the surface layer is thicker.

Included with this soil in mapping were areas of Aline and Attica soils. About 10 percent of the total acreage in this mapping unit consists of areas of Aline soils, and 25 percent consists of areas of Attica soils.

About 70 percent of the acreage of this Pratt soil is used for small grains and grain sorghum. The rest is mainly in native range, but a small acreage is used to grow weeping lovegrass for tame pasture.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by using a deep-furrow drill to plant crops, by planting crops at right angles to the direction of prevailing winds, and by protecting the soil with an adequate cover of crop residue at seeding time. Fertilizer is generally needed, and crops respond well to applications of a complete fertilizer. Proper fertilization helps growing crops provide a cover that protects the soil from erosion. It also helps them produce abundant residue that can be left on the soil surface or can be returned to the soil to help to control erosion. Properly fertilized weeping lovegrass, used for tame pasture, grows well and effectively controls erosion. Capability unit IIIe–7; Deep Sand range site: tame pasture suitability group 9A; Sandy tree suitability group.

Pratt loamy fine sand, 3 to 8 percent slopes (PtC).—This gently sloping or sloping soil occurs in areas where the surface is uneven. It is on uplands, on low dunes, and in narrow valleys between the dunes. The profile is the one described as representative of the Pratt series.

Included with this soil in mapping were areas of Attica and Carwile soils that make up, respectively, 5 percent and 3 percent of the total acreage in this mapping unit. Also included were small areas of Tivoli soils.

About 65 percent of the acreage of this Pratt soil is used to grow small grains, grain sorghum, and tame pasture grasses and legumes that provide feed and forage for livestock. Some areas are in native range.

Controlling soil blowing and maintaining soil fertility are the main concerns of soil management. Soil blowing can be controlled by using a deep-furrow drill for planting crops, by planting crops at right angles to the direction of prevailing winds, and by protecting the soils with an adequate cover of crop residue at seeding time. Fertilizer is generally needed, and crops respond well to applications of a complete fertilizer. Proper fertilization helps growing crops provide a cover that protects the soil from erosion. It also helps them produce abundant residue that can be left on the soil surface or can be returned to the soil to help in controlling erosion. Properly fertilized weeping lovegrass, used for tame pasture, grows well and effectively controls erosion. Capability unit IVe–3; Deep Sand range site; tame pasture suitability group 9A; Sandy tree suitability group.

Quinlan Series

Soils of the Quinlan series are well drained and are very gently sloping through steep. They have formed under a cover of tall, mid, and short grasses in material weathered from silty sandstone.

In a representative profile (fig. 7), the surface layer is reddish-brown silt loam about 10 inches thick. The subsoil, also reddish-brown silt loam, extends to a depth of about 16 inches. It is underlain by reddish-brown, calcareous sandstone.

Permeability is moderately rapid. Available water capacity is moderate to low.

Representative profile of Quinlan silt loam in a cultivated area of Woodward-Quinlan complex, 1 to 3 percent slopes, 1,010 feet east and 70 feet north of the southwest corner of sec. 36, T. 25 N., R. 11 W.:

A1—0 to 10 inches, reddish-brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak, medium, granular structure; hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

B2—10 to 16 inches, reddish-brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak, medium, subangular blocky structure; hard, friable; few very fine concretions of calcium carbonate; few small fragments of sandstone; calcareous; moderately alkaline; clear, wavy boundary.

C—16 to 24 inches, reddish-brown (5YR 5/4), calcareous sandstone; common light greenish-gray spots.

The A horizon is brown, reddish-brown, dark-brown, or strong-brown silt loam, loam, or silty clay loam. It is mildly alkaline or moderately alkaline, and it is calcareous in most places. The B2 horizon has the same textural range as the A horizon and is reddish brown, brown, dark brown, strong brown, or yellowish red. The C horizon is reddish brown, reddish yellow, or yellowish red. Thickness of the solum ranges from 10 to 20 inches.

Quinlan soils are associated with Woodward, Nash, and Grant soils. The solum of Quinlan soils is thinner than those of the associated soils.

Quinlan-Woodward complex, 3 to 5 percent slopes (QwC).—This mapping unit consists of gently sloping soils on uplands. About 40 percent of the acreage is Quinlan soils, and 35 percent is Woodward soils. An additional 10 percent consists of areas of Nash soils that were included during mapping, and another 10 percent consists of included areas of soils that have a profile similar to that of Woodward soils but that have a dark-colored surface layer and a silty clay loam subsoil. Other inclusions making up the remaining acreage consists of areas of Quinlan and Woodward soils so eroded that the plow layer is a mixture of material from the remaining original surface layer and the subsoil.

Quinlan soils are on crests, on the upper parts of slopes, and on microcrests of side slopes. Their profile is

Figure 7.—**Profile of Quinlan silt loam.**

similar to the one described as representative of the Quinlan series, except that the surface layer is loam in some places. Woodward soils are on foot slopes and on side slopes, between areas of Quinlan soils. Their profile is similar to the one described as representative of the Woodward series, except that the surface layer is loam in places.

Soils of this mapping unit are better suited to small grains than to other crops. About 40 percent of the acreage is used for small grains, grain sorghum, and grasses grown for tame pasture. The rest is in native range.

Controlling water erosion, maintaining desirable soil structure and fertility, and overcoming the limitations imposed by the shallowness of these soils are the main concerns of soil management. If at seeding time, these soils do not have an adequate cover of crop residue on the soil surface, terraces are needed and farming should be done on the contour to reduce runoff and erosion. Where adequate conservation practices are used, the terraces can be more widely spaced than if such practices are lacking. Water erosion can be controlled, soil structure can be improved, and soil fertility can be maintained by returning an adequate amount of crop residue to the soils each year and by adding supplemental applications of needed fertilizer. Management practices suitable for the areas used for range are discussed in the section "Use of the Soils for Range." Capability unit IVe-1; Quinlan part, Shallow Prairie range site and tame pasture suitability group 14A; Woodward part, Loamy Prairie range site and tame pasture suitability group 11A; Shallow tree suitability group.

Quinlan-Woodward complex, 5 to 30 percent slopes (QwE).—In this mapping unit are soils that are sloping through steep and are on uplands. About 45 percent of the acreage is Quinlan soils, and 30 percent is Woodward soils. About 5 percent consists of areas of Grant soils that were included during mapping; 5 percent consists of areas of Port soils that were included during mapping; and about 15 percent consists of included areas of soils that have a profile similar to that of Woodward soils but that have a silty clay loam subsoil.

Quinlan soils are on crests, on the upper parts of slopes, and on microcrests of side slopes. They have a profile similar to the one described as representative of the Quinlan series, except that the surface layer is loam or silty clay loam in places. Woodward soils are on foot slopes and on side slopes between areas of Quinlan soils. They have a profile similar to the one described as representative of the Woodward series, except that the surface layer is loam or very fine sandy loam in some places.

Soils of this mapping unit are not suitable for cultivated crops. They are used mainly for native range, but a small acreage is seeded to grasses grown for tame pasture. Management practices suitable for the areas used for range are discussed in the section "Use of the Soils for Range." Pasture grasses suitable for the soils used for tame pasture are given in the section "Use of the Soils for Tame Pasture." Capability unit VIe-4; Quinlan part, Shallow Prairie range site and tame pasture suitability group 14A; Woodward part, Loamy Prairie range site and tame pasture suitability group 11A; Shallow tree suitability group.

Reinach Series

The Reinach series consists of nearly level, well-drained soils on terraces. These soils formed in loamy sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile, the surface layer is brown very fine sandy loam about 26 inches thick. To a depth of 54 inches, the underlying material is also brown very fine sandy loam. Below that depth, it is dark grayish-brown silt loam.

Permeability is moderate. Available water capacity is high.

Representative profile of Reinach very fine sandy loam in a cultivated field, 230 feet east and 130 feet south of the northwest corner of sec. 24, T. 28 N., R. 11 W.:

Ap—0 to 7 inches, brown (7.5YR 4/3) very fine sandy loam, dark brown (7.5YR 3/3) moist; weak, medium, granular structure; slightly hard, very friable; mildly alkaline; clear, smooth boundary.

A1—7 to 26 inches, brown (7.5YR 4/3) very fine sandy loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; mildly alkaline in upper part of horizon and moderately alkaline and calcareous below a depth of 20 inches; diffuse, wavy boundary.

C—26 to 54 inches, brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 3/4) moist; massive; slightly hard, friable; weakly stratified below a depth of 45 inches; few fine threads of calcium carbonate; calcareous; moderately alkaline; abrupt, smooth boundary.

A1b—54 to 75 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; many fine threads of calcium carbonate; calcareous; moderately alkaline.

Depth to soft, powdery carbonates is more than 29 inches. The A horizon is brown or dark brown and is neutral to moderately alkaline in reaction. The A1 horizon is very fine sandy loam or silt loam. The C horizon is brown or reddish-brown very fine sandy loam or silt loam that is neutral to moderately alkaline in reaction. An A1b horizon of brown, dark-brown, or dark grayish-brown silt loam or very fine sandy loam is common in these soils.

Reinach soils are associated with Attica, Dale, McLain, and Port soils. They have a less well developed profile than Attica soils and are less clayey at depths between 10 and 40 inches than Dale, McLain, and Port soils.

Reinach very fine sandy loam (Ra).—This is a nearly level soil on smooth terraces. It is above the level reached by normal overflow, and it therefore is rarely flooded. Flooding occasionally occurs for brief periods, however, both in spring and in fall.

Included with this soil in mapping were areas of Dale soils, and areas of soils that have a profile similar to that of Reinach soils but that have a dark-colored surface layer less than 20 inches thick. About 5 percent of the total acreage in this mapping unit consists of included areas of Dale soils, and about 10 percent consists of areas that have a similar profile but that have a thinner surface layer.

Among the many crops to which this Reinbach soil is well suited are small grains, sorghum, and alfalfa. This soil is also suited to grasses grown for tame pasture and to native plants used for range. Most of the acreage is in small grains, alfalfa, and grain sorghum.

Maintaining desirable soil structure and fertility are the main concerns of soil management. Returning a moderate to large amount of crop residue to the soil each year and adding supplemental applications of a suitable fertilizer help to maintain desirable soil structure and soil fertility. Periodically changing the depth of tillage and performing tillage at a time when the least compaction is likely to occur are practices that reduce the risk that a tillage pan will form. Capability unit I-1; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Renfrow Series

In the Renfrow series are nearly level or very gently sloping, well-drained soils on uplands. These soils formed in material weathered from shale and clayey sediment. The vegetation was tall and mid grasses.

In a representative profile, the surface layer is dark grayish-brown silt loam about 8 inches thick. The upper part of the subsoil is dark-brown silty clay loam that extends to a depth of about 44 inches. The middle part is reddish-brown silty clay that extends to a depth of about 44 inches. The lower part of the subsoil is yellowish-red silty clay loam.

Permeability is very slow. Available water capacity is high.

Representative profile of Renfrow silt loam, 0 to 2 percent slopes, in a cultivated field, 750 feet east and 275 feet north of the southwest corner of sec. 16, T. 24 N., R. 10 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B1—8 to 14 inches, dark-brown (10YR 3/3) silty clay loam, very dark brown (10YR 2/2) moist; weak, medium, blocky structure parting to moderate, medium, granular; hard, firm; neutral; gradual, smooth boundary.

B2t—14 to 44 inches, reddish-brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate, coarse, blocky structure; extremely hard, extremely firm; distinct, nearly continuous clay films on ped surfaces; common medium concretions of calcium carbonate below a depth of 30 inches; moderately alkaline and calcareous below a depth of 30 inches; gradual, smooth boundary.

B3—44 to 65 inches, yellowish-red (5YR 5/6) silty clay loam, yellowish red (5YR 3/6) moist; common spots of light greenish gray (5GY 7/1); weak, coarse, blocky structure; extremely hard, very firm; patchy clay films; calcareous; moderately alkaline.

The Ap horizon is brown, dark brown, reddish brown, grayish brown, or dark grayish brown and is slightly acid or neutral in reaction. The B1 horizon is brown, dark brown, or reddish brown and is neutral or mildly alkaline in reaction. The B2t horizon is reddish-brown or yellowish-red silty clay loam, silty clay, or clay that is neutral to moderately alkaline in reaction. The B3 horizon is yellowish-red, reddish-brown, or red silty clay loam, silty clay, or clay that is mildly alkaline or moderately alkaline.

Renfrow soils are associated with Pond Creek and Grant soils. They have more clay in the upper part of their B horizon than Pond Creek and Grant soils.

Renfrow silt loam, 0 to 2 percent slopes (RcA).—This soil is on uplands. It is nearly level or very gently sloping.

Included with this soil in mapping were areas of Grant and Tabler soils. About 2 percent of the total acreage in this mapping unit consists of areas of Grant soils, and about 3 percent consists of areas of Tabler soils.

This Renfrow soil is better suited to small grains than to other crops, and it is poorly suited to sorghum. Grain sorghum can be grown, however, and this soil is suited to barley, to grasses grown for tame pasture, and to plants used for native range. Small grains, principally wheat, are the main crops.

Controlling water erosion, maintaining desirable soil structure, and overcoming the droughtiness of this soil are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface at seeding time. If a large amount of crop residue is returned to the soil, applications of nitrogen fertilizer are needed. Capability unit

IIIe-1; Claypan Prairie range site; tame pasture suitability group 8C; Clayey tree suitability group.

Ruella Series

The Ruella series consists of nearly level or very gently sloping, well-drained soils on uplands. These soils formed in calcareous, loamy sediment under a cover of tall and mid grasses.

In a representative profile, the surface layer is brown loam about 8 inches thick. The subsoil is light reddish-brown loam that extends to a depth of about 35 inches. The underlying material is reddish-yellow loam.

Permeability is moderate. Available water capacity is high.

Representative profile of Ruella loam, 0 to 2 percent slopes, in a cultivated field, 1,275 feet east and 190 feet north of the southwest corner of sec. 12, T. 24 N., R. 12 W.:

Ap—0 to 8 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; weak, medium, granular structure; slightly hard, friable; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B2—8 to 35 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak, coarse, prismatic structure; slightly hard, friable; few films, threads, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—35 to 75 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; common films, threads, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline.

Concretions of calcium carbonate range from few to common at all depths. The B2 horizon is strong brown, reddish brown, light reddish brown, or reddish brown. The C horizon is reddish yellow, reddish brown, or strong brown.

Ruella soils are associated with Pond Creek, Attica, and Shellabarger soils. They have lighter colored, thinner A and B horizons than Pond Creek soils and have a less well developed profile than Attica and Shellabarger soils.

Ruella loam, 0 to 2 percent slopes (RuA).—This soil is on uplands. It is nearly level or gently sloping.

Included with this soil in mapping were areas of Attica soils and areas of soils that have a profile similar to that of Ruella soils but that have a surface layer in which the color is outside the range of the Ruella series. About 5 percent of the total acreage in this mapping unit consists of areas of Attica soils, and 15 percent consists of areas of soils that have a surface layer of a different color.

This Ruella soil is well suited to small grains and sorghum. Most of the acreage is used for those crops, but some areas are in native range or tame pasture.

Maintaining desirable soil structure and fertility and controlling water erosion are the main concerns of soil management. Soil structure and fertility can be improved and erosion can be controlled by returning an adequate amount of crop residue to the soil and by applying a suitable fertilizer. Where the cover of crop residue on the soil surface is inadequate for protecting this soil from erosion, terraces are needed and farming should be on the contour. Capability unit IIe-1; Loamy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Salorthids

Salorthids, locally called salt plains or salt flats, are nearly level and are somewhat poorly drained. They are on flood plains of broad, shallow lake basins, where they formed in saline, sandy and loamy sediment under a sparse cover of salt-tolerant mosses, grasses, and forbs. In many places the surface is nearly bare.

In a representative profile, the surface layer is reddish-brown very fine sandy loam about 14 inches thick. It is covered by a white, crystalline salt crust less than 1 inch thick. In the upper part, the underlying material is strong-brown loamy fine sand that contains thin layers of fine sandy loam. In the lower part, the underlying material is reddish-brown very fine sandy loam that contains thin layers of silt loam.

Permeability is moderately rapid through very slow. Available water capacity is low.

Representative profile in an area of Salorthids on a bare salt flat, 2,400 feet west and 1,600 feet north of the southeast corner of sec. 26, T. 27 N., R. 10 W.:

A11—0 to 1 inch, white (5YR 8/1) crystalline salt mixed with very fine sandy loam; massive; hard, friable; strongly affected by salinity; calcareous; moderately alkaline; abrupt, smooth boundary.

A12—1 to 14 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable; strongly affected by salinity; calcareous; moderately alkaline; diffuse, smooth boundary.

C1—14 to 30 inches, strong-brown (7.5YR 5/6) loamy fine sand, strong brown (7.5YR 4/6) moist; massive; slightly hard, very friable; contains thin layers of fine sandy loam that together make up about 20 percent of the horizon; bedding planes clearly evident; strongly affected by salinity; calcareous; moderately alkaline; clear, smooth boundary.

C2—30 to 60 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable; contains thin layers (1/8 to 1/4 inch thick) of silt loam that together make up about 5 percent of the soil material in the horizon; bedding planes clearly evident; strongly affected by salinity; calcareous; moderately alkaline.

The A12, C1, and C2 horizons all have the same color, texture, and content of salt. The colors are reddish brown, reddish yellow, light brown, brown, dark brown, strong brown, very pale brown, black, or very dark grayish brown. Textures are sand, loamy fine sand, fine sandy loam, loam, very fine sandy loam, silt loam, or clay loam, but in most places these horizons contain thin layers of material that have a different texture. The total content of salt is more than 4 percent.

Salorthids are associated with Drummond and Gracemont soils, but they have a higher content of salt than do those soils. They have a less well developed textural profile than Drummond soils.

Salorthids (Sa).—These nearly level soils are on flood plains of a broad, shallow lake basin. In Alfalfa County they are adjacent to the Great Salt Plains Reservoir. Frequent flooding occurs in spring and in fall, and the floodwaters remain for long periods. In some areas the profile is like the one described as representative of Salorthids. In others the surface layer is sand, loamy fine sand, fine sandy loam, silt loam, or clay loam.

Included with these soils in mapping were small areas of Gracemont and Drummond soils that are irregular in shape and occur at a slightly higher elevation than Salorthids. About 5 percent of the total acreage in this mapping unit consists of areas of Gracemont and Drummond soils.

Most areas of Salorthids are used for recreation, and some areas provide storage for floodwaters that are used by wildlife. In less than 1 percent of the acreage, some moss grows in small or large clusters. Capability unit VIIIs–1; range site and tame pasture suitability group not assigned; Undesirable tree suitability group.

Shellabarger Series

The Shellabarger series consists of very gently sloping, well-drained soils on uplands. The soils formed in loamy sediment under a cover of tall and mid grasses.

In a representative profile, the surface layer is brown fine sandy loam about 16 inches thick. The upper part of the subsoil is reddish-brown sandy clay loam that extends to a depth of about 42 inches. The lower part of the subsoil is red sandy clay loam that extends to a depth of about 52 inches. The underlying material is red fine sandy loam.

Permeability is moderate. Available water capacity is high.

Representative profile of Shellabarger fine sandy loam, 1 to 3 percent slopes, in a cultivated field 1,480 feet west and 140 feet south of the northeast corner of sec. 3, T. 23 N., R. 12 W.:

Ap—0 to 8 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, medium, granular structure; slightly hard, friable; few worm casts; slightly acid; clear, smooth boundary.

A1—8 to 16 inches, brown (7.5YR 4/3) fine sandy loam, dark brown (7.5YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; many worm casts; slightly acid; gradual, smooth boundary.

B1—16 to 24 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, coarse, prismatic structure; slightly hard, friable; numerous worm casts; neutral; gradual, smooth boundary.

B2t—24 to 42 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak, coarse, prismatic structure; hard, friable; thin, continuous clay films on ped surfaces; neutral; gradual, smooth boundary.

B3—42 to 52 inches, red (2.5YR 5/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak, coarse, prismatic structure; slightly hard, friable; moderately alkaline; diffuse, smooth boundary.

C—52 to 66 inches, red (2.5YR 5/6) fine sandy loam, dark red (2.5YR 3/6) moist; massive; slightly hard, friable; few very fine concretions of calcium carbonate; calcareous in spots; moderately alkaline.

The A horizon is brown, dark brown, or grayish brown and is medium acid or slightly acid. The B1 horizon is brown, dark brown, or reddish brown and is slightly acid or neutral in reaction. The B2t horizon is reddish brown, light reddish brown, or yellowish brown and is neutral or mildly alkaline in reaction. The B3 horizon is red, light reddish brown, reddish brown, or yellowish red and is sandy clay loam or fine sandy loam. It is neutral to moderately alkaline in reaction.

Shellabarger soils are associated with Attica, Pond Creek, and Ruella soils. They have a more clayey B horizon than Attica soils, have a more sandy B horizon than Pond Creek soils, and have a more developed textural profile than Ruella soils. Shellabarger soils have a profile similar to that of Albion and Grant soils. They have a more clayey B horizon than Albion soils and have a more sandy B horizon than Grant soils.

Shellabarger fine sandy loam, 1 to 3 percent slopes (ShB).—This soil is on uplands. It is very gently sloping.

Included with this soil in mapping were areas of Carwile, Attica, and Pratt soils. About 2 percent of the total acreage in this mapping unit consists of areas of Carwile soils, about 3 percent consists of areas of Attica soils, and about 2 percent consists of areas of Pratt soils.

This Shellabarger soil is used mainly for wheat and grain sorghum. To some extent, it is used for oats, barley, vetch, alfalfa, and grasses grown for tame pasture. It is also suitable for native range.

Maintaining desirable soil structure and fertility and controlling soil blowing and water erosion are the main concerns of soil management. Soil structure and fertility can be improved and soil blowing and water erosion can be controlled by applying the proper kinds and amounts of fertilizer and by returning an adequate amount of crop residue to the soil. Other practices that help to control soil blowing and water erosion consist of using a deep-furrow drill and of planting crops at right angles to the direction of prevailing winds. A complete fertilizer is generally required. Properly fertilized weeping lovegrass, used for pasture, grows well and effectively controls soil blowing and water erosion. Capability unit IIe–2; Sandy Prairie range site; tame pasture suitability group 8A; Loamy Upland tree suitability group.

Tabler Series

The Tabler series consists of nearly level, moderately well drained soils on uplands. These soils formed in loamy and clayey sediment under a cover of tall and mid grasses.

In a representative profile, the surface layer is dark grayish-brown silty clay loam about 10 inches thick. The upper part of the subsoil is dark grayish-brown silty clay that extends to a depth of about 32 inches. The lower part of the subsoil is grayish-brown silty clay that is mottled with very dark gray and extends to a depth of about 48 inches. The underlying material is grayish-brown silty clay loam that is mottled with brownish and grayish colors.

Permeability is very slow. Available water capacity is high.

Representative profile of Tabler silty clay loam, 0 to 1 percent slopes, in a cultivated field, 900 feet south and 80 feet west of the northeast corner of sec. 17, T. 28 N., R. 12 W.:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; hard, friable; slightly acid; clear, smooth boundary.

B21t—10 to 32 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, blocky structure; extremely hard, very firm; nearly continuous clay films on ped surfaces; neutral; gradual, smooth boundary.

B22t—32 to 48 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; few, fine, faint, very dark gray mottles; weak, coarse, blocky structure; extremely hard, very firm; patchy clay films on ped surfaces; many fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—48 to 70 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; common, fine, distinct and faint, yellowish-brown and dark-gray mottles; massive; very hard, firm; calcareous; moderately alkaline.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, or very dark gray and is slightly acid or neutral in reaction. The B2t horizon is dark grayish-brown, very dark grayish-brown, grayish-brown, or very dark gray silty clay or clay that is mottled with gray or very dark gray below a depth of 26 inches. In some areas the profile contains a B3 horizon of calcareous and moderately alkaline clay, silty clay loam, or silty clay. The C horizon is brown, grayish brown, or light brownish gray and is mottled with brownish or grayish colors.

Tabler soils are associated with Pond Creek soils, and they have a profile similar to that of Brewer soils. They have more clay in the upper part of their B horizon than do Pond Creek soils, and they have a thinner A horizon than Brewer soils.

Tabler silty clay loam, 0 to 1 percent slopes (TaA).—This soil is on uplands, where in places it occurs in slight depressions. It is nearly level.

Included with this soil in mapping were areas of Pond Creek soils that together make up about 10 percent of the total acreage of this mapping unit. Also included was a small acreage consisting of a Tabler soil that has a surface layer of silt loam.

Small grains, principally wheat, are the main crops, but some areas are used for grain sorghums, alfalfa, grasses grown for tame pasture, and native range. This soil is better suited to small grains than to other crops. It is poorly suited to sorghum.

Improving the intake of water, maintaining desirable soil structure and fertility, and providing adequate surface drainage are the main concerns of soil management. Working a moderate to large amount of crop residue into the surface layer improves the intake of water and helps to keep this soil in good tilth. Applications of nitrogen fertilizer are needed if a large amount of crop residue is returned to the soil. Land smoothing can be used to improve surface drainage. Capability unit IIs–1; Claypan Prairie range site; tame pasture suitability group 8C; Clayey tree suitability group.

Tivoli Series

The Tivoli series consists of sloping to steep, excessively drained soils on uplands. These soils formed in sandy sediment under a cover of tall and mid grasses and scattered woody plants, mainly sand plum and skunkbrush.

In a representative profile, the surface layer is pale-brown fine sand about 9 inches thick. The underlying material is very pale brown fine sand.

Permeability is rapid. Available water capacity is low to moderate.

Representative profile of Tivoli fine sand in native range, 2,050 feet east and 1,350 feet north of the southwest corner of sec. 13, T. 27 N., R. 9 W.:

A1—0 to 9 inches, pale-brown (10YR 6/3) fine sand, dark brown (10YR 4/3) moist; weak, very fine, granular structure; loose, very friable; many roots; slightly acid; gradual, wavy boundary.

C—9 to 75 inches, very pale brown (10 YR 7/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; few, thin, horizontal bands of loamy fine sand below a depth of 62 inches; very few roots below a depth of 40 inches; slightly acid.

The A horizon is brown, light brown, pale brown, or light yellowish brown and is slightly acid or neutral in reaction. The C horizon is very pale brown, pale brown, brown, strong brown, light yellowish brown, or yellowish brown. Reaction of the C horizon is slightly acid to mildly alkaline to a depth of 40 inches and is neutral through moderately alkaline below that depth.

Tivoli soils are associated with Aline and Goltry soils, but they do not have a developed textural profile like those of the associated soils. They have a profile similar to that of Dillwyn soils, but they lack the water table that is at a depth of 15 to 60 inches in Dillwyn soils.

Tivoli fine sand (Tr).—This is a strongly sloping to steep soil on uplands where the surface is uneven. It is on dunes and in narrow valleys between the dunes.

Included with this soil in mapping were areas of Aline and Pratt soils. About 5 percent of the total acreage in this mapping unit consists of areas of Aline soils, and about 3 percent consists of areas of Pratt soils.

This Tivoli soil is too sandy and the areas on dunes are too steep to to be suitable for cultivated crops. Nearly all of the acreage is in range.

This soil is subject to severe damage from soil blowing. Careful management of the native plants is necessary to keep active blowouts from starting. Management practices suitable for the areas used for range are discussed in the section "Use of the Soils for Range." Capability unit VIIe–1; Dune range site; tame pasture suitability group not assigned; Very Sandy tree suitability group.

Woodward Series

The Woodward series consists of very gently sloping to steep, well-drained soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from sandstone.

In a representative profile, the surface layer is reddish-brown silt loam about 8 inches thick. Below the surface layer is a layer of red silt loam about 4 inches thick. The subsoil is red silt loam that extends to a depth of about 27 inches. The underlying material is red, weakly compacted sandstone.

Permeability is moderate. Available water capacity is high.

Representative profile of Woodward silt loam in a cultivated area of Woodward-Quinlan complex, 1 to 3 percent slopes, 2,365 feet west and 135 feet south of the northeast corner of sec. 36, T. 25 N., R. 11 W.:

Ap—0 to 8 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, friable; calcareous in spots; moderately alkaline; clear, smooth boundary.

A1—8 to 12 inches, red (2.5YR 5/6) silt loam, dark red (2.5YR 3/6) moist; moderate, fine, granular structure; slightly hard; friable; numerous fine roots and worm casts; calcareous; moderately alkaline; diffuse, irregular boundary.

B2—12 to 27 inches, red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; weak, coarse, prismatic structure; slightly hard, friable; few threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C—27 to 34 inches, red (2.5YR 5/6), weakly compacted, fine-grained sandstone, red (2.5YR 4/6) moist; calcareous.

The A and the B horizons are silt loam, loam, or very fine sandy loam. The A1 horizon is red, brown, dark brown, yellowish brown, reddish brown, or yellowish red, and it is neutral to moderately alkaline in reaction. The B2 horizon is red, reddish brown, brown, yellowish red, or strong brown.

Woodward soils are associated with Quinlan, Grant, and Nash soils. They have a thicker solum than Quinlan soils and have a less well developed textural profile than Grant soils. Unlike Nash soils, Woodward soils are calcareous.

Woodward-Quinlan complex, 1 to 3 percent slopes (WuB).—Soils of this mapping unit are on uplands and are very gently sloping. About 50 percent of the acreage is Woodward soils, and 40 percent is Quinlan soils. The rest consists of areas of Grant, Albion, and Nash soils that were included during mapping.

Woodward soils are on side slopes. They have the profile described as representative of the Woodward series in most places, but the surface layer is loam in some places. Quinlan soils are on crests. They have the profile described as representative of the Quinlan series in most places, but the surface layer is loam in some places.

Soils of this mapping unit are better suited to small grains and sorghum than to other crops. They are also suited to grasses grown for tame pasture and to native plants used for range. Most of the acreage is in wheat, oats, barley, and grain sorghum.

Maintaining desirable soil structure and fertility and controlling water erosion are the main concerns of soil management. Returning an adequate amount of crop residue to these soils and applying the proper kinds and amount of fertilizer will improve soil structure, maintain soil fertility, and help to control erosion. Where the amount of crop residue on the soil surface at seeding time is inadequate for protecting these soils from erosion, terraces are needed. Applications of a suitable fertilizer are needed where these soils are used for crops. Capability unit IIIe-4; Woodward part, Loamy Prairie range site and tame pasture suitability group 11A; Quinlan part, Shallow Prairie range site and tame pasture suitability group 14A; Shallow tree suitability group.

Yahola Series

In the Yahola series are nearly level, well-drained soils on flood plains. These soils formed in loamy and sandy sediment under a cover of tall grasses and scattered cottonwood and elm trees.

In a representative profile (fig. 8), the surface layer is brown fine sandy loam about 8 inches thick. The upper part of the underlying material extends to a depth of about 32 inches and is brown fine sandy loam that contains thin layers of loamy fine sand, loam, and silt loam. The lower part of the underlying material is light reddish-brown very fine sandy loam that contains thin layers of fine sandy loam and loam.

These soils are free of salts or are only slightly affected by salts below a depth of 40 inches. Permeability is moderately rapid. Available water capacity is high.

Representative profile of Yahola fine sandy loam in a cultivated area of Yahola soils, 1,200 feet west and 200 feet north of the southeast corner of sec. 1, T. 27 N., R. 11 W.:

Ap—0 to 8 inches, brown (7.5YR 4/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C1—8 to 32 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; structureless (massive); slightly hard, very friable; contains a few thin layers (one-eighth inch to 2 inches thick) of loamy fine sand, loam, and silt loam; calcareous; moderately alkaline; diffuse, smooth boundary.

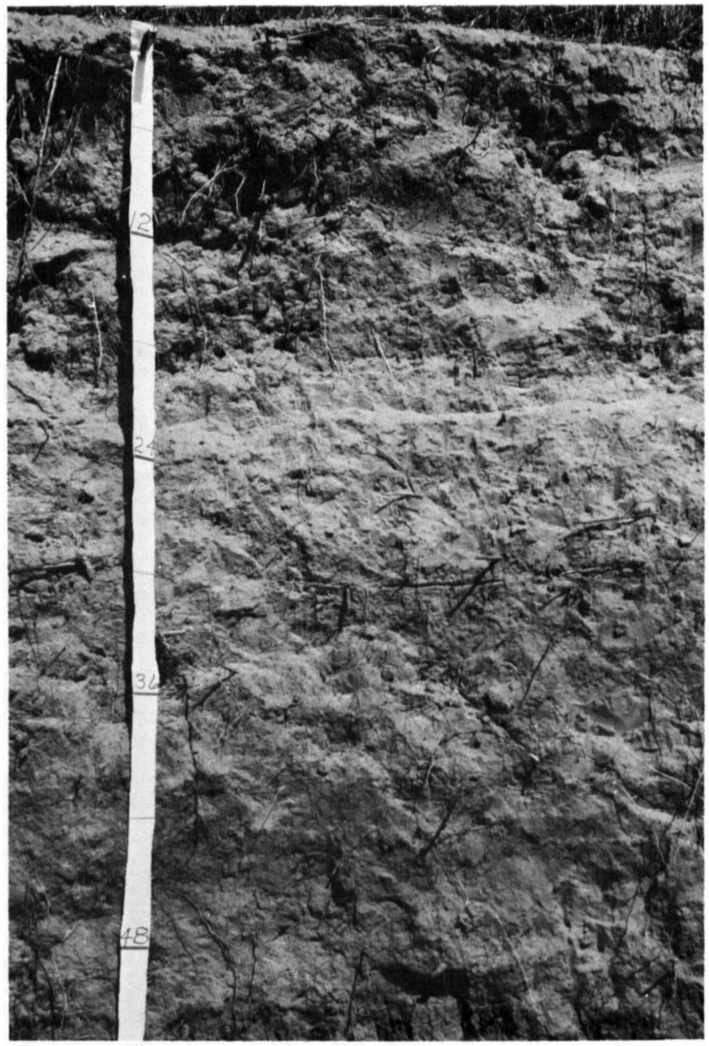

Figure 8.—**Profile of Yahola fine sandy loam.**

C2—32 to 75 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; contains thin layers of fine sandy loam and loam; calcareous; moderately alkaline.

The A horizon is brown, strong-brown, yellowish-brown, dark yellowish-brown, reddish-brown, or yellowish-red fine sandy loam, very fine sandy loam, or loam that is mildly alkaline or moderately alkaline. The C horizon is brown, strong brown, light brown, reddish brown, light reddish brown, yellowish red, or reddish yellow. It contains thin layers of coarser textured or finer textured material.

Yahola soils are associated with Crisfield, Port, Lincoln, and Gracemont soils. They differ from Crisfield soils in being calcareous, and they are less clayey at depths of 10 to 40 inches than Port soils. Yahola soils are less sandy at depths of 10 to 40 inches than Lincoln soils. They lack the high water table that is typical in Gracemont soils.

Yahola soils (Ya).—These nearly level soils are on flood plains. They are occasionally flooded, but the water table is generally at a depth of more than 60 inches. In most places the profile is the one described as representative of the Yahola series, but the surface layer is very fine sandy loam or loam in some areas.

Included with these soils in mapping were areas of Lincoln soils, of Port soils, and of soils that have a profile similar to that of Yahola soils but that have colors in the surface layer that are outside the range of the Yahola series. About 3 percent of the total acreage in this mapping unit consists of Lincoln soils, about 3 percent consists of Port soils, and about 20 percent consists of soils that have a similar profile, except for the color of the surface layer.

These Yahola soils are used mainly for small grains, grain sorghum, and alfalfa. They are also suited to grasses grown for tame pasture and to native plants used for range.

Maintaining desirable soil structure and fertility, controlling soil blowing, and providing protection from flooding are the main concerns of soil management. Returning a moderate to large amount of plant residue to these soils each year and applying supplemental applications of needed fertilizer are practices that maintain fertility at a high level. Soil blowing can be controlled by keeping a moderate amount of plant residue on the soil surface. The risk that a tillage pan will form can be reduced by changing the depth of tillage from time to time and by tilling only when the soils are not wet. Capability unit IIw-3; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Yahola and Port soils, frequently flooded (Yp).—This mapping unit consists of soils that are flooded at least once each year and that are flooded several times in some years. The water table is at a depth of more than 60 inches. These soils are nearly level or very gently sloping. They do not occur in a regular pattern but occur in areas large enough that the soils could be mapped separately. The soils are mapped together, however, because they are similar in use and management.

About 45 percent of the acreage is Yahola soils, and 40 percent is Port soils. Part of the remaining acreage consists of included soils that have a profile similar to that of Port soils but that have a less clayey subsoil. The rest consists of included areas of soils that have a profile similar to those of both the Yahola and Port soils but that have a water table above a depth of 60 inches.

The Yahola soils have a profile similar to the one described as representative of the Yahola series, except that the surface layer is very fine sandy loam or loam in places. The Port soils have a profile similar to the one described as representative of the Port series, except that they are more stratified; have a surface layer of loam, silty clay loam, or clay loam in places; and in some places are slightly affected by salts below a depth of 40 inches.

Soils of this mapping unit are not suited to cultivated crops but are suited to grasses grown for tame pasture. They are used mainly for native range, recreation, and wildlife habitat. Practices suitable for managing areas used for range are discussed in the section "Use of the Soils for Range." Grasses suitable for tame pasture are given in the section "Use of the Soils for Tame Pasture." Capability unit Vw-3; Loamy Bottomland range site; tame pasture suitability group 2A; Loamy Bottomland tree suitability group.

Use and Management of the Soils

This section contains information about use and management of the soils for cultivated crops and tame pasture and discusses use of the soils for range, for planting trees, and for wildlife habitat. It also describes uses of the soils for engineering purposes.

Management of the Soils for Cultivated Crops [2]

This section briefly discusses some general management practices needed to protect cultivated soils of this county from water erosion and soil blowing. It also explains the system of capability classification used in the United States and gives predicted average acre yields of the principal crops grown under two levels of management. Additional suggestions about the management needed for individual soils are given in the section "Descriptions of the Soils."

The principal crops generally grown in this county are wheat, barley, sorghum, and alfalfa. Of these crops, wheat and barley, grown during the cool part of the year, provide protection from water erosion and soil blowing in winter. Sorghum, which is drought resistant, grows during the hot, dry summers. Soils used each year for these crops must be managed so that they maintain their fertility and desirable structure and are also protected from water erosion and soil blowing. For most of the soils used for cultivated crops, a combination of practices is needed.

Keeping a cover of growing crops on the surface of cultivated soils, and properly managing crop residue, are practices that help to control water erosion and soil blowing. For some soils, terraces needed, however, can be reduced by using suitable supporting practices, or the need for terraces may be eliminated altogether. One such practice, which for some soils provides all the protection needed, consists of maintaining 500 to 1,000 pounds of stubble per acre on the soil surface each year at the time the new crop is seeded. Where this practice is applied, terraces are not needed for areas of such soils as the Attica fine sandy loam that has slopes of 3 to 4 percent or for areas of Shellabarger fine sandy loam that has slopes of 2 to 3 percent. Terraces spaced 300 feet apart are needed for areas of Grant silt loams that have slopes of as much as 4 percent.

Where small grains are grown each year, and where about 2,000 pounds of straw is plowed under by about July 1, terraces spaced approximately 225 feet apart are needed for areas of such soils as the Attica and Shellabarger that have slopes of 3 percent. If a small grain or sorghum is grown year after year, and if about 2,000 pounds of stubble or other crop residue is plowed under each year, terraces spaced about 125 feet apart are needed for areas of Grant silt loams that have slopes of 3 percent. Terraces spaced about 125 feet apart are also needed for these areas of Grant soils if grain sorghum is grown as a row crop and is planted on the contour.

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[2] ERNEST HILL, agronomist, Soil Conservation Service, assisted in preparing this section.

Weeds, insects, and diseases can be controlled by using chemicals. Where necessary, changes can be made in the cropping sequence.

Protection from soil blowing is needed if such soils as the Pratt and Attica loamy fine sands and the Aline and the Goltry fine sands are cultivated. If some soils, as for example Shellabarger soils, are adequately protected from soil blowing, widely spaced terraces are all that are needed for controlling water erosion.

To control soil blowing, it is necessary to keep a growing crop on the soil or to maintain an adequate cover of crop residue on the soil surface during the period when damaging winds are most prevalent. An additional practice that helps to control soil blowing consists of using a semideep-furrow drill or a deep-furrow drill and of running in an east-west direction the ridges made by the drill. Where such drills are used, soil blowing is controlled if only about half as much crop residue is kept on the soil surface as is needed where the soil is not ridged by this method. Using an 8-inch drill for seeding crops does not provide adequate control of soil blowing, for the drill leaves such small furrows and ridges that the areas are not really ridged.

Where the soil surface is not ridged and the field is one-half mile wide, 1,700 pounds of straw per acre is required for controlling soil blowing and water erosion on the Pratt soils and on other soils that have a surface layer of loamy fine sand. Only 1,100 pounds of straw per acre is needed to protect the soils where the same field is seeded with a 10-inch semideep-furrow drill and the furrows are run in an east-west direction.

In some places effective protection from soil blowing is provided by planting trees in shelterbelts and by practicing stripcropping. In fields where stripcropping is practiced, the rows are run in an east-west direction.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming. They can also find suggestions about soil management in the descriptions of the mapping units.

The capability grouping is based on limitations of soils used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils that are used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or saline, and *c*, used in only some parts of the United States but not in Alfalfa County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation: the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The placement of any mapping unit in the grouping can be learned by referring to the capability unit designation given at the end of the mapping unit description or by turning to the "Guide to Mapping Units" at the back of this survey. Following is a descriptive outline of the system as it applies to Alfalfa County.

Class I. Soils that have few limitations that restrict their use. (No subclass.)
- Unit I-1. Deep, nearly level, well drained or moderately well drained soils that are loamy throughout; on terraces.
- Unit I-2. Deep, nearly level, well-drained soils that are loamy throughout; on uplands.
- Unit I-3. Deep, nearly level, well-drained soils that are loamy throughout; on terraces.

Class II. Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if not protected.
  - Unit IIe-1. Deep, nearly level or very gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIe-2. Deep, very gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIe-3. Deep, nearly level or very gently sloping, well-drained soils that are moderately coarse textured throughout; on uplands.

Subclass IIw. Soils that have moderate limitations because of excess water or seasonal overflow.

Unit IIw-1. Deep, nearly level or very gently sloping, somewhat poorly drained or well-drained, loamy soils that have a clayey or loamy subsoil; on uplands.

Unit IIw-2. Deep, nearly level, well-drained soils that are loamy throughout; on flood plains.

Unit IIw-3. Deep, nearly level, well-drained, loamy soils that are underlain by loamy material containing thin layers of sandy sediment; on flood plains.

Subclass IIs. Soils that have moderate limitations because of very slow permeability.

Unit IIs-1. Deep, nearly level, moderately well drained, loamy soils that have a clayey or loamy subsoil; on uplands.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are not protected.

Unit IIIe-1. Deep, nearly level or very gently sloping, well-drained, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit IIIe-2. Deep, gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIIe-3. Deep, gently sloping, well-drained, eroded soils that are loamy throughout; on uplands.

Unit IIIe-4. Moderately deep or shallow, very gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIIe-5. Deep, very gently sloping or gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIIe-6. Deep, gently sloping or sloping, well-drained soils that are loamy throughout; on terraces.

Unit IIIe-7. Deep, nearly level or very gently sloping, well-drained, sandy soils that have a sandy or loamy subsoil; on uplands.

Subclass IIIw. Soils that have severe limitations because of wetness or seasonal flooding.

Unit IIIw-1. Deep, nearly level, moderately well drained, clayey soils that have a clayey or loamy subsoil; on uplands.

Subclass IIIs. Soils that have severe limitations because of soil features.

Unit IIIs-1. Deep, nearly level or very gently sloping, moderately well drained, well drained, or somewhat poorly drained, loamy soils that have a loamy or clayey subsoil that is moderately affected or strongly affected by salts; on terraces.

Unit IIIs-2. Deep, nearly level, well-drained or somewhat excessively drained soils that have a loamy surface layer and subsoil and sandy underlying material; on uplands.

Class IV. Soils that have very severe limitations that reduce the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe-1. Deep, moderately deep, or shallow, gently sloping or sloping, well-drained, eroded and noneroded soils that are loamy throughout; on uplands.

Unit IVe-2. Deep, gently sloping, well-drained or somewhat excessively drained soils that are loamy throughout; on uplands.

Unit IVe-3. Deep, gently sloping or sloping, well-drained soils that are sandy throughout; on uplands.

Unit IVe-4. Deep, gently sloping, well-drained or somewhat excessively drained, eroded soils that are loamy throughout; on uplands.

Unit IVe-5. Deep, sloping, well-drained or somewhat excessively drained, eroded soils that are loamy throughout; on uplands.

Subclass IVw. Soils that have very severe limitations because of wetness during some seasons.

Unit IVw-1. Deep, nearly level or very gently sloping, somewhat poorly drained soils that are sandy throughout and have a seasonal high water table; on uplands.

Subclass IVs. Soils that have very severe limitations because of soil features that reduce the choice of plants, require careful management, or both.

Unit IVs-1. Deep, nearly level or very gently sloping, well drained, moderately well drained, or somewhat excessively drained, sandy soils that have a sandy or loamy subsoil; on uplands.

Class V. Soils that are not likely to erode but that have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Subclass Vw. Soils subject to seasonal flooding or that have a seasonal high water table.

Unit Vw-1. Deep, nearly level, somewhat poorly drained, loamy soils that have a loamy subsoil and are moderately or strongly affected by salinity; on flood plains.

Unit Vw-2. Deep, nearly level or very gently sloping, somewhat excessively drained, sandy or loamy soils that have a sandy subsoil; on flood plains.

Unit Vw-3. Deep, nearly level or very gently sloping, well-drained, loamy or sandy soils that have a loamy subsoil; on flood plains.

Subclass Vs. Soils that are affected by salinity and that have a high seasonal water table.

Unit Vs-1. Deep, nearly level or very gently sloping, somewhat poorly drained, loamy soils that have a loamy or clayey subsoil and are moderately or strongly affected by salinity; on terraces.

Unit Vs–2. Deep, nearly level or very gently sloping, somewhat poorly drained or well-drained, loamy or sandy soils that have a loamy, clayey, or sandy subsoil and are moderately or strongly affected by salinity; on terraces and uplands.

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture, range, woodland, or wildlife.

Subclass VIe. Soils limited chiefly by risk of erosion if protective cover is not maintained.

Unit VIe–1. Deep, sloping to moderately steep, somewhat excessively drained or well-drained soils that are loamy throughout; on uplands.

Unit VIe–2. Deep, sloping or strongly sloping, somewhat excessively drained or excessively drained soils that are sandy throughout; on uplands.

Unit VIe–3. Deep, nearly level to strongly sloping, well drained soils that are loamy throughout; on uplands or flood plains.

Unit VIe–4. Shallow or moderately deep, sloping to steep, well-drained soils that are loamy throughout; on uplands.

Class VII. Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIIe–1. Deep, strongly sloping to steep, excessively drained soils that are sandy throughout; on uplands.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

Subclass VIIIs. Soils very severely limited by salinity.

Unit VIIIs–1. Deep, nearly level, somewhat poorly drained soils that are stratified and have thin layers of loamy or sandy material throughout and that are strongly affected by salinity; on flood plains.

Predicted yields

Predicted average acre yields of the principal dryland crops and of grasses grown for tame pasture are shown in table 2. The predictions are for two levels of management.

Values in columns A are predicted average acre yields to be expected under the ordinary management practiced by a substantial number of farmers in the county. Such management consists of seeding at proper rates; planting on proper dates; using efficient methods of harvesting; controlling weeds, insects, and diseases to insure normal growth of plants; farming on the contour; constructing terraces where needed; and applying a suitable fertilizer.

Values in columns B are predicted average acre yields that can be expected under improved management. This level of management consists of planting improved varieties of crops at the proper rate and at the proper time; using efficient methods of harvesting; applying a fertilizer that fits the specific needs indicated by soil tests; supplying surface drainage where needed; practicing good management of crop residue; using tillage methods that reduce soil erosion to a minimum and that maintain soil structure, increase water infiltration, and aid in the emergence of seedlings; using a cropping system that is fitted to the operator's goals and to the soils; and conserving and using rainfall effectively.

The yield values not only take into account years when weather was normal, but they also take into account years when crops failed because weather was abnormal. Yields were estimated by soil scientists who surveyed the soils. The soil scientists made their estimates through observation, through consultation with farmers, and by collaboration with personnel of Oklahoma State University.

Use of the Soils for Tame Pasture

For the purpose of managing soils used for tame pasture, the soils of Alfalfa County that are suitable for this use have been placed in tame pasture suitability groups. All the soils in each group are suited to the same pasture plants and require about the same kind of management. On all the soils in the group, production of forage is about the same. Table 2 gives predicted average acre yields of the principal grasses used for tame pasture under two levels of management.

In the following paragraphs, the soils in each tame pasture suitability group are briefly described and names of grasses suitable for the soils of each group are given. The groups are not numbered consecutively, because they are numbered according to a statewide system and not all the groups are represented in this county. Names of all the soils in each group can be learned by referring to the "Guide to Mapping Units" at the back of this publication. Salorthids and Tivoli soils are too sandy or too saline to be suited to grasses grown for tame pasture.

Group 1a.—In this group are deep, moderately well drained soils that have a clayey surface layer and a clayey or loamy subsoil. These soils are on flood plains and are subject to flooding. Tall wheatgrass, tall fescue, and bermudagrass are suitable grasses.

Group 2a.—This group consists mainly of deep soils that have a loamy surface layer and a loamy subsoil. It also includes small areas of sandy soils. The soils are moderately well drained or well drained and are subject to flooding. They are on flood plains or terraces. Lovegrass, tall fescue, and bermudagrass are suitable grasses.

Group 2c.—This group consists of deep, somewhat poorly drained or moderately well drained soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are on flood plains or terraces. They are moderately or strongly affected by salinity. Tall wheatgrass (fig. 9) and alkali sacaton are suitable grasses. Bermudagrass can be grown (fig. 10), but establishing a stand of bermudagrass is difficult (fig. 11).

TABLE 2.—*Predicted yields per acre of principal dryland crops and tame pasture under two levels of management*

[Yields in columns A are those to be expected under ordinary management; yields in columns B are those to be expected under improved management. Absence of a yield figure indicates that the crop is not generally grown on the soil at the specified level of management]

Soil	Dryland crops								Tame pasture					
	Wheat		Barley		Grain sorghum		Alfalfa		Improved bermudagrass		Tall wheatgrass		Lovegrass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]
Albion sandy loam, 0 to 1 percent slopes	15	25	21	36	25	40			2.5	4.0			3.0	4.5
Albion sandy loam, 1 to 3 percent slopes	14	22	21	36	25	35			2.5	4.0			3.0	4.5
Albion sandy loam, 3 to 5 percent slopes	12	18	15	25	20	30			2.0	3.5			2.5	4.0
Albion sandy loam, 5 to 15 percent slopes									1.5	2.5			2.0	3.0
Albion-Grant complex, 3 to 5 percent slopes	14	22	20	35	25	35			2.0	3.5			2.5	4.0
Albion-Grant complex, 3 to 5 percent slopes, eroded	10	20	18	30	20	30			1.5	2.5			2.0	3.5
Albion-Grant complex, 5 to 8 percent slopes, eroded	10	18	15	25	15	25			1.5	2.5			2.0	3.0
Aline fine sand, 0 to 3 percent slopes	10	15			15	25			2.5	3.5			3.0	4.0
Aline-Tivoli complex, 5 to 12 percent slopes													2.0	3.0
Attica loamy fine sand, 0 to 3 percent slopes	14	22	15	25	20	35	1.0	2.0	3.0	4.5			3.0	4.5
Attica fine sandy loam, 0 to 3 percent slopes	15	25	20	36	22	40	1.5	2.5	3.0	5.0			3.0	4.5
Attica fine sandy loam, 3 to 5 percent slopes	12	20	15	28	18	32			2.8	4.5			2.5	4.0
Brewer silt loam	25	36	38	55	40	60	3.0	5.0	4.5	7.0	4.5	7.0	4.5	6.5
Brewer-Drummond complex	15	22	25	35	25	35	2.5	4.5	4.0	6.0	4.0	6.0		
Carwile-Attica complex, 0 to 3 percent slopes	15	23	20	35	20	40	1.5	2.8	4.0	6.0			3.0	4.5
Crisfield fine sandy loam	20	28	25	40	25	45	2.5	3.5	4.5	6.0			4.5	6.5
Dale silt loam, 0 to 1 percent slopes	25	38	38	45	40	55	3.5	5.5	5.5	7.5	5.5	7.5	4.5	7.0
Dale silt loam, saline	20	26	30	35	30	45	2.8	4.5	4.5	6.0	4.5	6.0		
Dale soils, 3 to 8 percent slopes	15	25	25	35	30	45	2.0	3.0	4.0	5.5	4.0	5.5	3.5	5.5
Dillwyn loamy fine sand	14	24	20	35	20	35	1.5	3.5	3.5	6.5	3.5	6.0	3.5	5.0
Dougherty fine sand, 0 to 3 percent slopes	12	20	14	25	18	32		1.5	3.0	4.5			2.5	5.0
Drummond soils, 0 to 3 percent slopes									3.0	5.0	3.5	4.5		
Drummond-Pratt complex, 0 to 3 percent slopes									3.0	4.0	3.0	4.0		
Goltry fine sand, 0 to 3 percent slopes	10	20	20	30	20	30			3.5	5.5			3.5	5.5
Gracemont soils									3.0	5.0	3.5	4.5		
Grant silt loam, 1 to 3 percent slopes	22	30	32	42	35	45	2.0	2.5	4.0	6.0			4.5	6.0
Grant silt loam, 3 to 5 percent slopes	18	25	22	35	25	38		2.0	3.0	5.0			3.5	5.0
Grant silt loam, 3 to 5 percent slopes, eroded	14	22	18	30	20	33			2.0	4.0			2.5	4.5
Grant-Nash complex, 3 to 8 percent slopes, eroded	12	20	15	25	18	30			2.0	3.5			2.5	4.0
Grant-Port complex, 0 to 12 percent slopes									3.0	4.5			3.0	4.5
Lincoln soils									3.5	4.5			3.0	4.5
McLain silt loam	25	36	38	45	40	60	3.0	5.0	4.5	7.0	4.5	7.0	4.5	7.0
Miller clay	16	22	20	35	25	38	1.2	2.5	4.0	5.5	4.0	5.5		
Pond Creek silt loam, 0 to 1 percent slopes	23	35	35	50	35	50	2.0	3.0	5.0	6.5			4.5	6.0
Pond Creek silt loam, 1 to 3 percent slopes	20	31	32	45	32	45	1.8	2.8	4.5	6.0			4.0	5.5
Port silt loam	23	38	33	45	40	55	3.0	5.0	5.5	7.5	5.0	7.0	4.5	7.0
Pratt loamy fine sand, 0 to 3 percent slopes	12	20	15	25	25	40			2.5	4.0			3.0	4.5
Pratt loamy fine sand, 3 to 8 percent slopes	10	18	12	20	20	35			2.0	3.0			2.5	3.5
Quinlan-Woodward complex, 3 to 5 percent slopes	10	15	15	25	18	25			1.5	2.5			2.0	3.0
Quinlan-Woodward complex, 5 to 30 percent slopes									1.5	2.5			2.0	3.0
Reinach very fine sandy loam	22	32	30	45	35	50	3.0	4.5	5.5	7.0			4.5	7.0
Renfrow silt loam, 0 to 2 percent slopes	16	25	20	35	20	35			2.0	3.5				
Ruella loam, 0 to 2 percent slopes	16	25	24	36	30	45			3.5	5.0			4.0	5.5
Salorthids														
Shellabarger fine sandy loam, 1 to 3 percent slopes	16	28	22	38	30	45	1.5	2.5	4.0	5.5			4.5	5.5
Tabler silty clay loam, 0 to 1 percent slopes	20	28	30	45	30	40	1.5	2.0	3.0	4.0				
Tivoli fine sand														
Woodward-Quinlan complex, 1 to 3 percent slopes	12	20	18	30	20	35			3.0	4.0			3.0	4.0
Yahola soils	20	30	30	40	30	45	2.7	4.0	4.0	6.0			4.5	7.0
Yahola and Port soils, frequently flooded									4.0	6.5			4.5	7.0

[1] AUM means animal-unit-month, a term used to express the carrying capacity of pasture. The values are the number of months that 1 acre will provide grazing for one animal unit (one cow, steer, or horse; five hogs; or seven sheep) without damage to the pasture.

Figure 9.—**First-year growth of tall wheatgrass on soils of Brewer-Drummond complex.**

Figure 10.—**First-year growth of Midland bermudagrass on soils of Brewer-Drummond complex.**

GROUP 3A.—This group consists of deep, somewhat excessively drained soils that are mainly sandy and have a sandy subsoil, but it includes a small acreage of loamy soils. The soils are on flood plains and are subject to flooding. Suitable grasses are bermudagrass and weeping lovegrass.

GROUP 8A.—In this group are deep soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are on uplands. Most of them are well drained, but the soils in a small part of the acreage are somewhat poorly drained. Bermudagrass and weeping lovegrass are suitable grasses.

GROUP 8C.—This group consists of deep, well drained or moderately well drained soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are an uplands. Bermudagrass is a suitable grass.

GROUP 9A.—In this group are deep, excessively drained, somewhat excessively drained, or well-drained soils that have a sandy surface layer and a loamy or sandy subsoil. These soils are on uplands. Bermudagrass and weeping lovegrass are suitable grasses.

Figure 11.—**Midland bermudagrass on soils of Brewer-Drummond complex. Long runners are spreading across an area of saline soil. The grass will gradually cover this area.**

Group 9c.—This group consists of deep, moderately well drained or somewhat poorly drained soils that are sandy throughout and have a high water table. These soils are on uplands. Bermudagrass, tall wheatgrass, and weeping lovegrass are suitable grasses.

Group 11a.—In this group are mostly moderately deep soils that have a loamy surface layer and a loamy subsoil, but it includes small areas of deep soils. These soils are on uplands. Bermudagrass and weeping lovegrass are suitable grasses.

Group 14a.—This group consists of shallow, well-drained soils that have a loamy surface layer and a loamy subsoil. These soils are on uplands. Weeping lovegrass and bermudagrass are suitable grasses.

Use of the Soils for Range

This part of the soil survey gives information about use of the soils for range. It describes the grouping of soils into range sites and discusses management of the soils in each range site.

Range is land on which the natural plant community is composed mainly of grasses, grasslike plants, forbs, and shrubs that are valuable for grazing and that are abundant enough to justify use for grazing by domestic animals. Most of the areas used for range are in small livestock farms, but a few large ranches are located in this county. In 1969 the county had a total of 91,903 cattle and calves and 7,538 sheep and lambs, according to records of the U.S. Bureau of the Census. About 20 percent of the total number of cattle and calves consisted of cows and their calves. The rest were stocker cattle.

Range sites and condition classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage, if the range is in similar condition, make up a range site.

Range sites are kinds of rangeland that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does not change as long as the environment remains unchanged. Throughout the prairie and the plains, the climax vegetation consists of the plants that were growing there when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers, and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Hence, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is less than 25.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

A primary objective of good range management is to keep rangeland in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. The problem is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods, under the supervision of a careful manager, may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites [3]

In the following pages, the range sites of Alfalfa County are described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield of air-dry herbage for each site when the site is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey. The only mapping unit not placed in a range site is Salorthids.

Specific information about stocking range sites is not included in this publication. Help in classifying range sites, in estimating the conditions of the range, and in determining the number of animals to stock can be obtained from technicians of the local agricultural agencies.

CLAYPAN PRAIRIE RANGE SITE

This site consists of deep, nearly level or very gently sloping, loamy soils that have a clayey or loamy subsoil. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 25 percent; big bluestem, 20; switchgrass, 15; and indiangrass, 10. The remaining 30 percent is made up of about equal amounts of side-oats grama, blue grama, buffalograss, lead-plant and Illinois bundleflower, goldenrod, and coralberry.

This range site produces about 4,000 pounds of air-dry herbage per acre in favorable years and 2,000 pounds per acre in less favorable years. Approximately 95 percent of the herbage is from plants that provide forage for cattle and sheep.

Under continuous intensive grazing by cattle, little bluestem, big bluestem, switchgrass, indiangrass, lead-plant, and bundleflower decrease in the plant community. Side-oats grama, blue grama, buffalograss, goldenrod, coralberry, and similar plants increase. If overgrazing is allowed to continue for a long time, three-awn, silver bluestem, ragweed, and common broomweed replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist or regulating grazing, of following a planned system of grazing of controlling weeds and brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

DEEP SAND RANGE SITE

In this site are deep, nearly level to strongly sloping, sandy soils that have a loamy or sandy subsoil. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 30 percent; sand bluestem, 20; and indiangrass, 10. The remaining 40 percent is made up of about equal amounts of switchgrass, sand lovegrass, Texas bluegrass, tall dropseed, Illinois bundleflower, queensdelight, bigtop dalea, and woody plants.

This range site produces about 4,000 pounds of air-dry herbage per acre in favorable years and 1,800 pounds per acre in less favorable years. Approximately 95 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, little bluestem, sand bluestem, indiangrass, switchgrass, sand lovegrass, and Illinois bundleflower decrease in the plant community. Texas bluegrass, tall dropseed, bigtop dalea, queensdelight, sand plum, and skunkbrush increase. If overgrazing is allowed to continue for a long time, sandbar, sand dropseed, red lovegrass, deervetch, wild buckwheat, camphorweed, locust, and coralberry replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced. Decreasers that disappear under continuous intensive grazing make up about 75 percent of the total production on the site; increasers make up about 20 percent; and woody plants make up the rest.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing and deferred grazing, of seeding desirable range plants, of controlling brush and weeds, and of developing well-distributed and adequate supplies of water for livestock.

DUNE RANGE SITE

Tivoli fine sand is the only soil in this range site. This soil is deep, is strongly sloping through steep, and is sandy throughout. It is on uplands (fig. 12).

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 30 percent; sand bluestem, 20; big sandreed and Illinois bundleflower, 10; and Texas bluegrass, 10. The remaining 30 percent is made up of about equal parts of sand dropseed, sand lovegrass, Scribner panicum, perennial lespedeza, bigtop dalea, and woody plants.

This range site produces about 2,220 pounds of air-dry herbage per acre in favorable years and 1,200 pounds per acre in less favorable years. Approximately 95 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, little bluestem, sand bluestem, sand lovegrass, big sandreed, perennial lespedeza, and Illinois bundleflower decrease in the plant community. Texas bluegrass, sand dropseed, Scribner panicum, bigtop dalea, skunkbrush, and sand plum increase. If overgrazing is allowed to continue for a long time, annual brome, mat sandbur, showy partridgepea, nightshade, wild buckwheat, and locust replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing (fig. 13), of following a planned system of grazing and deferred grazing, of controlling brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

[3] By DAVID ANKLE, range conservationist, Soil Conservation Service.

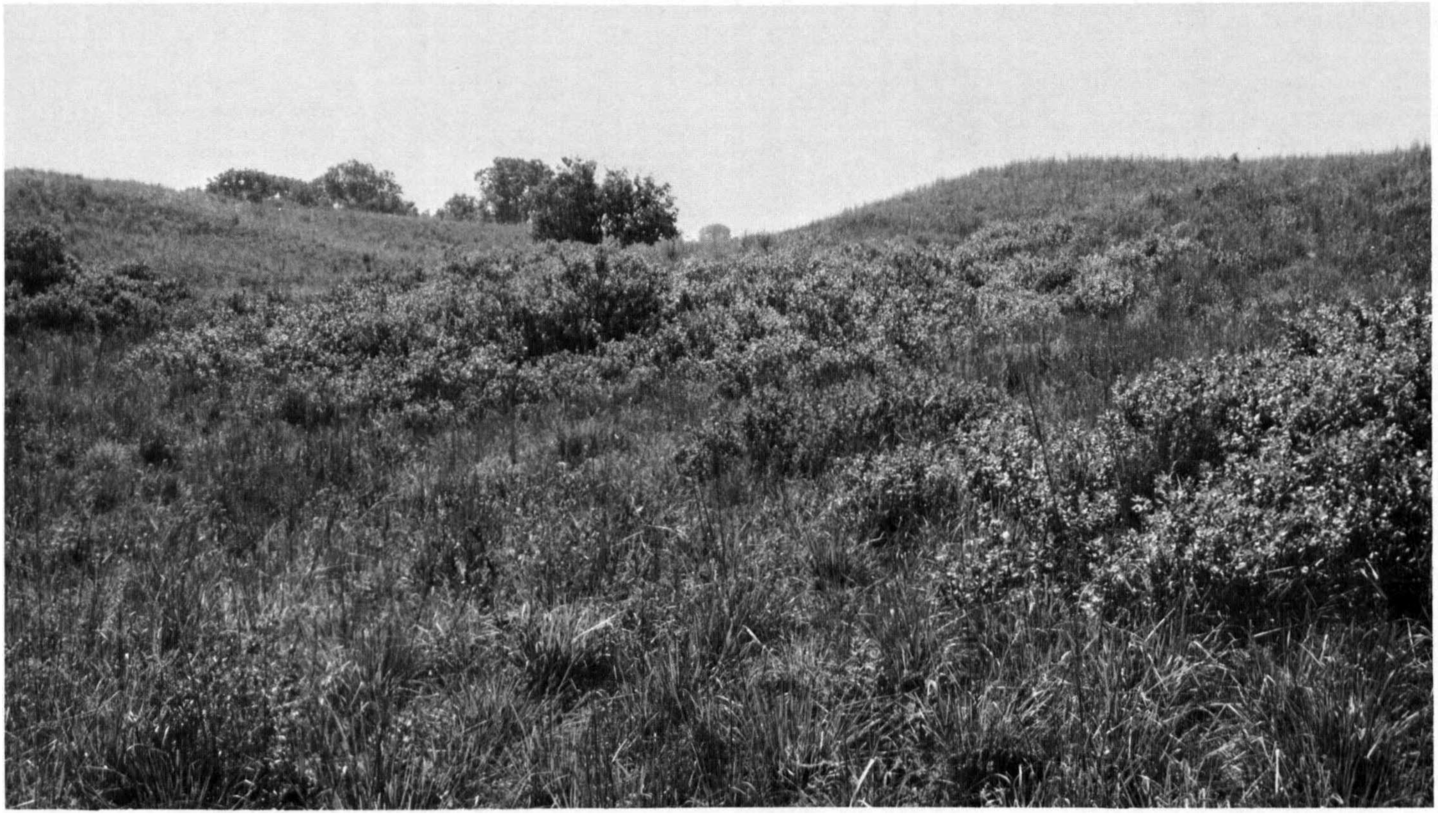

Figure 12.—An area of Dune range site in excellent condition. The soil is Tivoli fine sand.

HEAVY BOTTOMLAND RANGE SITE

The only soil in this range site is Miller clay, which is deep, is nearly level, and has a clayey or loamy subsoil. This soil is on flood plains.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: big bluestem, 25 percent; switchgrass, 15; indiangrass, 15; prairie cordgrass, 10; and woody plants, 10. The remaining 25 percent is made up of about equal amounts of western wheatgrass, tall dropseed, perennial sunflower, goldenrod, and sedge.

This range site produces about 4,500 pounds of air-dry herbage per acre in favorable years and 2,500 pounds per acre in less favorable years. Approximately 90 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, big bluestem, switchgrass, indiangrass, prairie cordgrass, and perennial sunflower decrease in the plant community. Western wheatgrass, tall dropseed, goldenrod, sedge, elm, ash, and sumac increase. If overgrazing is allowed to continue for a long time, barnyardgrass, annual brome, silver bluestem, seacoast sumpweed, ragweed, ironweed, and persimmon replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing and deferred grazing, of seeding desirable range plants, of controlling weeds and brush, and of developing well-distributed and adequate supplies of water for livestock.

LOAMY BOTTOMLAND RANGE SITE

This site consists of deep, nearly level to sloping soils that are loamy throughout. These soils are on terraces and flood plains.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: big bluestem, 25 percent; indiangrass, 15; switchgrass, 15; and little bluestem, 10. The remaining 35 percent is made up of about equal amounts of eastern gamagrass, beaked panicum, tall dropseed, compassplant, heath aster, sedge, and woody plants.

This range site produces about 7,500 pounds of air-dry herbage per acre in favorable years and 4,500 pounds per acre in less favorable years. Approximately 95 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, little bluestem, indiangrass, switchgrass, eastern gamagrass, little bluestem, and compassplant decrease in the plant community. Beaked panicum, tall dropseed, heath aster, sedge, elm, pecan, walnut, greenbrier, and similar plants increase. If overgrazing is allowed to continue for a long time, annual brome, silver bluestem, three-awn, ragweed, ironweed, and white snakeroot replace many of the more desirable forage plants and make up a substantial part

Figure 13.—An active blowout, caused by abuse of the vegetative cover, on Dune range site. The soil is Tivoli fine sand.

of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing, of controlling weeds and brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock (fig. 14).

LOAMY PRAIRIE RANGE SITE

This site consists of deep or moderately deep, nearly level through steep soils that are loamy throughout. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 25 percent; big bluestem or sand bluestem, 20; indiangrass, 10; and switchgrass, 10. The remaining 35 percent is made up of about equal amounts of Canada or Virginia wildrye, tall dropseed, side-oats grama, blue grama, perennial lespedeza, dotted gayfeather, and woody plants.

This range site produces about 5,000 pounds of air-dry herbage per acre in favorable years and 2,500 pounds per acre in less favorable years. Approximately 95 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, little bluestem, big bluestem, sand bluestem, switchgrass, indiangrass, Canada or Virginia wildrye, and perennial lespedeza decrease in the plant community. Tall dropseed, side-oats grama, blue grama, dotted gayfeather, sumac, sand plum, and similar plants increase. If overgrazing is allowed to continue for a long time, silver bluestem, annual brome, three-awn, showy partridgepea, common broomweed, ragweed, and yarrow replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing, of controlling weeds and brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

SALINE SUBIRRIGATED RANGE SITE

This site consists of deep, nearly level or very gently sloping, loamy soils that have a loamy or clayey subsoil that is moderately or strongly affected by salinity (fig. 15). These soils are on terraces or flood plains.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight; prairie cordgrass, 30 percent; switchgrass, 10; indiangrass, 10; and inland saltgrass, 10. The remaining 40 percent is made up of about equal amounts of little bluestem, vine mesquite, western wheatgrass, alkali sacaton, perennial sunflower, Illinois bundleflower, sedge, and woody plants.

This range site produces about 7,000 pounds of air-dry herbage per acre in favorable years and 5,000 pounds

Figure 14.—An area of Loamy Bottomland range site in excellent condition. The soil is Dale silt loam, saline.

per acre in less favorable years. Approximately 90 percent of the herbage is from plants that provide forage for cattle and sheep.

Under continuous intensive grazing by cattle, prairie cordgrass, switchgrass, little bluestem, indiangrass, vine mesquite, western wheatgrass, and perennial sunflower decrease in the plant community. Inland saltgrass, alkali sacaton, sedge, willow, baccharis, buttonbush, and similar plants increase. If overgrazing is allowed to continue for a long time, windmillgrass, stinkgrass, Kochia, smartweed, saltcedar, and cottonwood replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total percentage of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing and deferred grazing, of seeding desirable range plants, of controlling weeds and brush, of providing cattle walkways, and of developing well-distributed and adequate supplies of water for livestock.

SANDY BOTTOMLAND RANGE SITE

Only the mapping unit Lincoln soils is in this range site. These are deep, nearly level or very gently sloping soils that in most places have a sandy surface layer and a sandy subsoil. They are on flood plains.

The climax, or potential, plant community on this site is made up of the following plants, by percentage of total weight; switchgrass, 30 percent; sand bluestem, 15; and indiangrass, 15. The remaining 40 percent is made up of about equal amounts of little bluestem, Texas bluegrass, beaked panicum, purpletop, Maximillian sunflower, goldenrod, heath aster, and woody plants.

This range site produces about 3,500 pounds of air-dry herbage per acre in favorable years and 2,000 pounds per acre in less favorable years. Approximately 90 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, switchgrass, sand bluestem, indiangrass, little bluestem, and Maximillian sunflower decrease in the plant community. Texas bluegrass, beaked panicum, purpletop, goldenrod, heath aster, willow, cottonwood, and similar plants increase. If overgrazing is allowed to continue for a long time, sand dropseed, annual brome, sandbur, snakecotton, cocklebur, and saltcedar replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing and deferred grazing, of controlling brush and weeds, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

SANDY PRAIRIE RANGE SITE

This site consists of deep, nearly level through moderately steep, loamy soils that have a loamy or clayey subsoil. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 30 percent; sand bluestem, 15; switchgrass, 10; and indiangrass, 10. The remaining 35 percent is made up of about equal amounts of Scribner panicum, sand paspalum, side-oats grama, prairie clover, halfshrub sundrop, yucca, and woody plants.

This range site produces about 4,500 pounds of air-dry herbage per acre in favorable years and 2,000 pounds per acre in less favorable years. Approximately 90 percent of the herbage is from plants that provide forage for cattle or sheep.

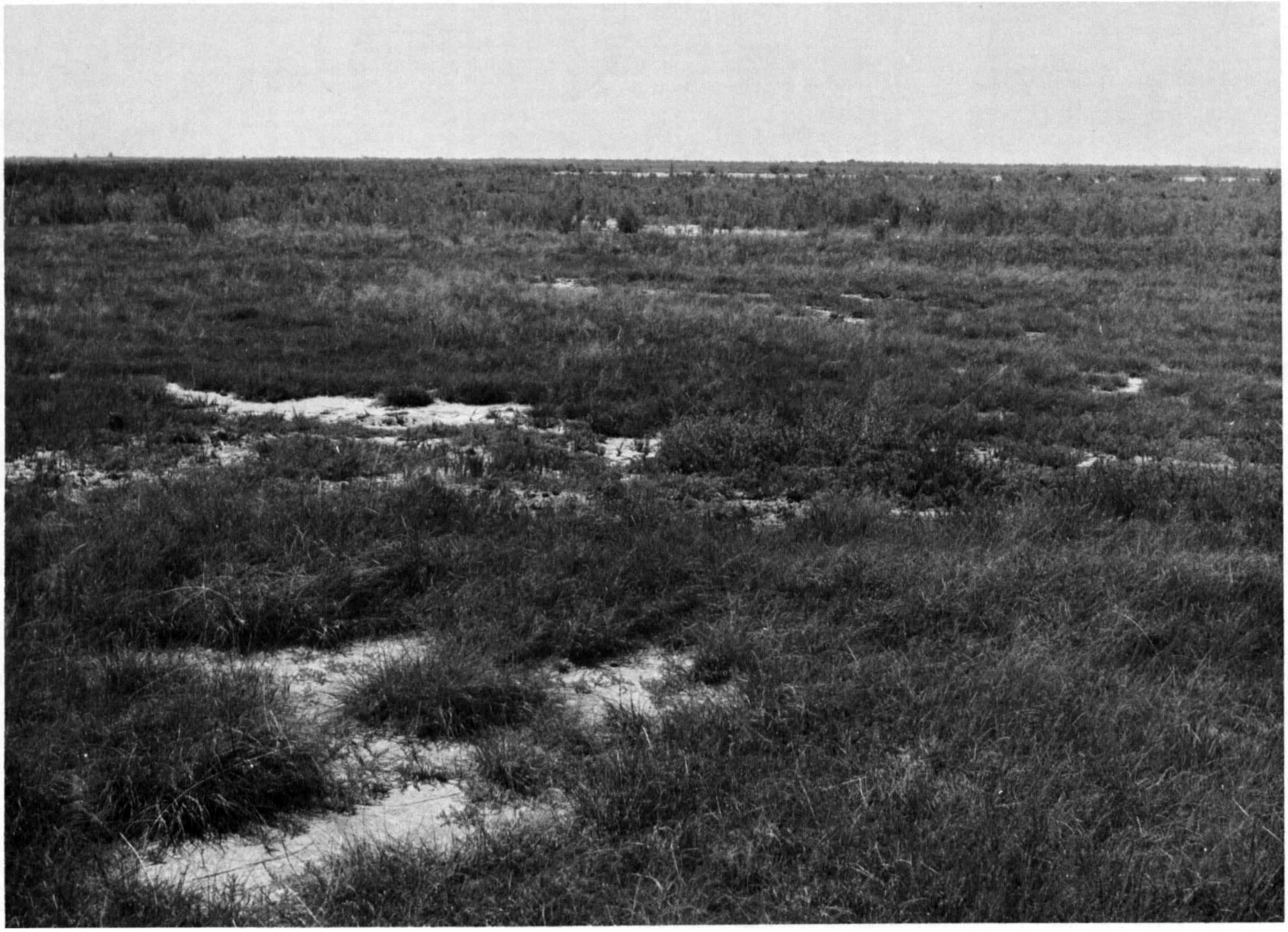

Figure 15.—**An extremely saline part of an area of Saline Subirrigated range site in excellent condition. A Gracemont soil occupies the saline spot.**

Under continuous intensive grazing by cattle, little bluestem, sand bluestem, switchgrass, indiangrass, prairie clover, and halfshrub sundrop decrease in the plant community. Scribner panicum, sand paspalum, side-oats grama, yucca, sumac, skunkbrush, coralberry, and similar plants increase. If overgrazing is allowed to continue for a long time, sand dropseed, stinkgrass, windmillgrass, sandbur, croton, nightshade, oak, and western soapberry replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing, of controlling weeds and brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

SHALLOW PRAIRIE RANGE SITE

This site consists of shallow, very gently sloping through steep soils that are loamy throughout. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: little bluestem, 30 percent; big bluestem, 15; indiangrass, 10; switchgrass, 10; and side-oats grama, 10. The remaining 25 percent is made up of about equal amounts of hairy grama, tall dropseed, perennial sunflower, dotted gayfeather, and woody plants.

This range site produces about 2,500 pounds of air-dry herbage per acre in favorable years and 1,500 pounds per acre in less favorable years. Approximately 15 percent of the herbage is from plants that provide forage for cattle or sheep.

Under continuous intensive grazing by cattle, little bluestem, big bluestem, indiangrass, switchgrass, and perennial sunflower decrease in the plant community. Side-oats grama, hairy grama, tall dropseed, dotted gayfeather, sumac, coralberry, blackberry, and similar plants increase. If overgrazing is allowed to continue for a long time, three-awn, ragweed, common yarrow, bitter sneezeweed, and persimmon replace many of the more desirable forage plants and make up a substantial part of the

annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing, of controlling brush and weeds, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

SUBIRRIGATED RANGE SITE

This site consists of deep, nearly level or very gently sloping soils that are sandy throughout and have a high water table. These soils are on uplands.

The climax, or potential, plant community on this range site is made up of the following plants, by percentage of total weight: switchgrass, 25 percent; sand bluestem or big bluestem, 20; indiangrass, 10; eastern gamagrass, 10; and beaked panicum, 10. The remaining 25 percent is made up of about equal amounts of wildrye, Scribner panicum, purpletop, Maximillian sunflower, and woody plants.

This range site produces about 9,000 pounds of air-dry herbage per acre in favorable years and 7,000 pounds per acre in less favorable years. Approximately 90 percent of the herbage is from plants that provide forage for cattle or sheep (fig. 16).

Under continuous intensive grazing by cattle, switchgrass, sand bluestem, big bluestem, indiangrass, eastern gamagrass, wildrye, and Maximillian sunflower decrease in the plant community. Scribner panicum, purpletop, beaked panicum, cottonwood, willow, and similar plants increase. If overgrazing is allowed to continue for a long time, johnsongrass, annual brome, broomsedge, showy partridgepea, ragweed, and ironweed replace many of the more desirable forage plants and make up a substantial part of the annual growth. Then, the total production of forage is greatly reduced.

Appropriate management practices on this site consist of regulating grazing, of following a planned system of grazing and deferred grazing, of controlling weeds and brush, of seeding desirable range plants, and of developing well-distributed and adequate supplies of water for livestock.

Use of the Soils for Planting Trees [4]

This section gives information about suitability of the soils of Alfalfa County for planting trees. Only a few natural stands of trees are in this county. Most of the trees and woody shrubs growing in natural stands are in narrow bands along the Salt Fork of the Arkansas River, the Medicine River, and tributaries of these two streams. Natural stands of post oak and blackjack oak also occupy small areas of Pratt, Carwile, and Attica soils in the southwestern part of the county. Ash, pecan, walnut, bur oak, mulberry, hackberry, Kentucky coffeetree, honeylocust, eastern redcedar, American elm, willow, soapberry, plum, chittamwood, sumac, buttonbush, salt-

[4] By NORMAN E. SMOLA, woodland conservationist, Soil Conservation Service.

Figure 16.—An area of Subirrigated range site in excellent condition. The soil is Goltry fine sand, 0 to 3 percent slopes. Sand dunes are in the background.

cedar, and roughleaf dogwood are native to this county. Other trees and shrubs used in windbreaks and post lots were introduced from other areas.

Except for their esthetic values and their value as protection for the watershed and for wildlife habitat, the trees in natural stands have only limited economic value. Such trees were valued by the early settlers, however, for the protection and shade they provided and for the material they supplied for fenceposts. Many landowners have continued to plant trees to protect their buildings, livestock, and soils. Trees in properly located and designed farmstead windbreaks planted by these landowners help to control the drifting of snow, and they keep snow out of farmyards. They also provide shelter for the homestead and can add hundreds of dollars to the value of a farm. Trees in field windbreaks help to control soil blowing in areas used for crops, especially in areas of sandy soils. They also protect crops from hot winds and from damage caused by wind. Field windbreaks are most effective when used in conjunction with appropriate agronomic practices.

In addition to their other uses, belts of trees and shrubs are useful for screening unsightly areas and for controlling erosion. Trees and shrubs can also function effectively as screens to reduce noise.

To be most effective, every planting of trees should be carefully planned. It is preferable to select the kind of trees that grow best on the particular kind of soil at the site selected for planting. Even though many different species of trees are native to this country, these trees seldom grow naturally on soils where trees are needed. If trees are planted in areas where they do not grow naturally, they need special care if they are to survive.

Where trees are to be planted, preparation of the site is about the same as that needed for ordinary field crops. In areas of soils that are not sandy, the site can be prepared far enough in advance that the soil material has time to settle. If trees are to be planted in an area used for alfalfa or grass sod, that area can be summer fallowed for at least 1 year before the trees are planted. Areas in field crops can be fall plowed. Where the soils are sandy, trees can be planted without any advance preparation of the site. A cover crop can be planted, that will protect the soils both before and after the trees are planted, and this crop also protects the young trees or shrubs.

Healthy seedlings can be obtained from a reputable nursery or other agency for planting late in winter or early in spring. The roots need protection from drying out while the seedling is being planted, and the soil ought to be packed firmly around the roots. Freshly planted seedlings need water, and water should be supplied as soon as possible after the seedling is planted.

Because the amount of rainfall is limited and rain falls only at irregular intervals, young trees planted in this county need considerable care if they are to survive and grow well. Control of weeds is needed, for weeds compete for moisture. They can be controlled by thoroughly cultivating the soils or by using a chemical weed killer. Protection is also needed from damage by livestock and fire. Additional information about the planting and care of trees and shrubs is available from a local representative of the Soil Conservation Service, from the State forester, and from the Extension forester who serves this county.

Soils in relation to trees

The kinds of soils and the soil-air-moisture relationships greatly influence the growth of trees in Alfalfa County. Trees generally grow best on sandy loams. Growth of trees is only fair to poor on clayey soils, for clayey soils release moisture at only a slow rate. Very sandy soils are also not well suited to trees, because they have low available water capacity and do not retain plant nutrients well. During the dry part of the year, deep soils hold more moisture available for trees than do soils that are shallow over bedrock or some other restrictive layer. Therefore, deep soils are better suited to trees than are shallow soils. Deciduous trees require a deeper soil than evergreens, but evergreens grow best on soils that are also well suited to farm crops. Such evergreens as pine and eastern redcedar at first grow more slowly than hardwoods or other deciduous trees. As evergreens mature, however, their growth is likely to equal that of hardwoods. Evergreens generally live longer than deciduous trees, and they are more effective than hardwoods where they are used as a screen or in a windbreak.

Tree suitability groups

To assist the landowner who wishes to plant trees on his property, the soils of Alfalfa County that have similar characteristics affecting the growth of trees have been placed in tree suitability groups. The trees and shrubs suggested for the soils in each group are named in the descriptions of the groups. The following paragraphs give a brief description of the soils in each tree suitability group. To find the names of all the soils in each group, refer to the "Guide to Mapping Units" at the back of this soil survey.

CLAYEY TREE SUITABILITY GROUP

This group consists of deep, moderately well drained or well drained, nearly level or gently sloping soils on uplands and flood plains. These soils have a surface layer and a subsoil that are clayey or loamy. The main hazard if they are used for trees and shrubs is competition from weeds and grass.

Trees and shrubs suitable for planting are—

- Evergreens: eastern redcedar, Austrian pine, ponderosa pine, and shortleaf pine.
- Medium to tall deciduous trees: mulberry, pin oak, bur oak, Kentucky coffeetree, hackberry, Osage-orange, green ash, and catalpa.
- Shrubs: lilac, autumn olive, American plum, and multiflora rose.

LOAMY BOTTOMLAND TREE SUITABILITY GROUP

In this group are deep, well drained or moderately well drained, nearly level or sloping soils on terraces and flood plains. These soils have a surface layer and a subsoil that are loamy. They are well suited to trees that can stand occasional wetness, but trees cannot grow where the soils are frequently flooded for long periods.

Trees and shrubs suitable for planting are—

- Evergreens: eastern redcedar, Austrian pine, shortleaf pine, and Scotch pine.
- Tall deciduous trees: cottonwood, sycamore, water oak, green ash, black walnut, and hackberry.

Shrubs: American plum, roughleaf dogwood, and buttonbush.

LOAMY UPLAND TREE SUITABILITY GROUP

In this group are mainly deep, well-drained, nearly level to moderately steep soils that have a loamy surface layer and subsoil and are on uplands. Also included in some places are areas of somewhat poorly drained and of somewhat excessively drained soils; areas of soils on flood plains; and areas of soils that have a clayey subsoil. The main hazard if these soils are used for young trees is competition from weeds and grass.

Trees and shrubs suitable for planting are—

Evergreens: eastern redcedar, Austrian pine, ponderosa pine, Scotch pine, and shortleaf pine.
Medium and tall deciduous trees: sycamore, bur oak, mulberry, green ash, honeylocust, Osage-orange, hackberry, catalpa, and Kentucky coffeetree.
Shrubs: American plum, lilac, desertwillow, tamarisk (saltcedar), autumn olive, and fragrant sumac.

MOIST SANDY TREE SUITABILITY GROUP

This group consists of deep, somewhat poorly drained or moderately well drained, nearly level or gently sloping soils on uplands. These soils are sandy and have a beneficial water table at a depth of 15 to 80 inches.

Trees and shrubs suitable for planting are—

Evergreens: eastern redcedar, shortleaf pine, Scotch pine, and Austrian pine.
Medium to tall deciduous trees: cottonwood, sycamore, water oak, honeylocust, green ash, and boxelder.
Shrubs: lilac, roughleaf dogwood, and buttonbush.

SALINE TREE SUITABILITY GROUP

In this group are deep, somewhat poorly drained, moderately well drained, or well drained, nearly level or very gently sloping soils. These soils are mainly on terraces or on flood plains, but, to some extent, they are on uplands. Most of these soils have a loamy surface layer and a loamy or clayey subsoil, but some of the soils are sandy. The soils in this group are moderately or strongly saline. The planting of trees and shrubs is not advisable in areas strongly affected by salinity.

Trees and shrubs suitable for planting in nonsaline areas and in those areas only moderately affected by salinity are—

Evergreen: eastern redcedar and ponderosa pine.
Medium to tall deciduous trees: green ash, honeylocust, cottonwood, and Russian-olive.
Shrubs: tamarisk (saltcedar).

SANDY TREE SUITABILITY GROUP

In this group are deep, well-drained or somewhat excessively drained, nearly level to sloping soils on uplands or flood plains. Most of these soils have a sandy surface layer and a sandy or loamy subsoil, but in some small areas they are loamy.

Soils of this group are suitable for planted trees if strips of sod or other vegetation are used between the rows of trees to control soil blowing. Cultivation should be restricted to the area nearest the row of trees. The main hazard to young trees grown on these soils is competition for soil moisture from grass and weeds.

Trees and shrubs suitable for planting are—

Evergreens: eastern redcedar, ponderosa pine, and Austrian pine.
Medium to tall deciduous trees: mulberry, green ash, honeylocust, sycamore, and Osage-orange.
Shrubs: American plum, desertwillow, and autumn-olive.

SHALLOW TREE SUITABILITY GROUP

This group consists of shallow or moderately deep, well-drained, very gently sloping to steep, loamy soils on uplands. In these soils moisture is in short supply. For this reason, the only species of tree suitable for planting is eastern redcedar.

UNDESIRABLE TREE SUITABILITY GROUP

This group consists of deep, somewhat poorly drained, nearly level soils on flood plains. These saline soils have a loamy or sandy surface layer and subsoil. Because of the low rate of survival of trees and shrubs, these soils should not be used for planting.

VERY SANDY TREE SUITABILITY GROUP

In this group are deep, somewhat excessively drained or excessively drained, sloping to steep, sandy soils on uplands. These soils cannot be safely cultivated. Young seedlings planted on them are subject to damage from winds of high velocity, and they can be covered and destroyed by drifting sand. Only the following trees and shrubs are suitable for planting on soils of this group—

Evergreen: eastern redcedar.
Shrubs: American plum.

Use of the Soils for Wildlife Habitat[5]

Soils directly influence the kinds and amounts of vegetation and the amount of water available in an area. In this way they indirectly influence the kinds of wildlife that live in the area. Soil properties that are significant in creating, maintaining, or improving suitable combinations of food, cover, and water that make up the wildlife habitat are texture of the surface layer, depth to which plant roots can penetrate, available water capacity, wetness, surface stoniness or rockiness, susceptibility to flooding, slope, and permeability to air and water.

Table 3 rates soils of Alfalfa County according to their suitability for eight elements of wildlife habitat and for three kinds of wildlife. The ratings take into account soil characteristics and closely related natural factors of the environment, but they do not take into account present land use, climate, or distribution of people and wildlife. The selection of an area for wildlife development requires onsite inspection and evaluation of factors involved in the environment. The ratings are described in the paragraphs that follow.

[5] By J. F. SYKORA, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for elements of*

[Soil rated *good* are well suited or above average; *fair*, suited or average;

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Woody plants: Hardwoods
Albion:				
AbA, AbB	Good	Good	Good	Poor
AbC, AgC, AgC2. For Grant part of AgC and AgC2, refer to Grant series.	Good	Good	Good	Poor
AbE, AgD2. For Grant part of AgD2, refer to Grant series.	Fair	Fair	Fair	Poor
Aline: AlB, AnE. For Tivoli part of AnE, refer to Tivoli series.	Fair	Fair	Fair	Poor
Attica:				
AsB, AtB	Good	Good	Good	Poor
AtC	Good	Good	Good	Poor
Brewer: Br, Bu. For Drummond part of Bu, refer to Drummond series.	Good	Good	Good	Poor
Carwile: CaB. For Attica part, refer to Attica series.	Fair	Fair	Good	Poor
Crisfield: Cr	Good	Good	Good	Poor
Dale:				
DaA, De	Good	Good	Good	Poor
DlD	Fair	Good	Good	Poor
Dillwyn: Dm	Fair	Fair	Good	Fair
Dougherty: DoB	Fair	Fair	Fair	Poor
Drummond: DrB, DtB. For Pratt part of DtB, refer to Pratt series.	Poor	Fair	Fair	Very poor
Goltry: GoB	Poor	Fair	Fair	Fair
Gracemont: Gp	Poor	Fair	Fair	Fair
Grant:				
GrB	Good	Good	Good	Poor
GrC, GrC2	Good	Good	Good	Poor
GtD2, GuE. For Nash part of GtD2 and Port part of GuE, refer to those series.	Fair	Good	Good	Poor
Lincoln: Ls	Poor	Fair	Fair	Fair
McLain: Mc	Good	Good	Good	Poor
Miller: Mr	Poor	Fair	Fair	Poor
Nash. Mapped only with Grant soils.	Fair	Good	Good	Very poor
Pond Creek: PcA, PcB	Good	Good	Good	Poor
Port: Pr	Fair	Good	Good	Fair
Port, frequently flooded. Mapped only with Yahola soils.	Poor	Fair	Fair	Poor
Pratt: PtB, PtC	Fair	Good	Good	Poor

See footnotes at end of table.

wildlife habitat and kinds of wildlife

poor, poorly suited or below average; and *very poor*, use is not feasible]

Elements of wildlife habitat—Continued				Kinds of wildlife		
Woody plants—Continued: Conifers	Wetland food and cover plants	Shallow water developments	Ponds	Openland	Woodland	Wetland
Poor	Very poor	Poor	Poor	Good	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Good	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Poor	Very poor	Good	Poor	Very poor.
Poor	Very poor	Very poor	Very poor	Good	Poor	Very poor.
Poor	Very poor	Good	Good [1]	Good	Poor	Poor.
Poor	Fair	Good	Fair [1]	Fair	Poor	Fair.
Poor	Very poor	Poor	Very poor	Good	Poor	Very poor:
Poor	Very poor	Fair	Fair [1]	Good	Poor	Poor.
Poor	Very poor	Very poor	Very poor	Good	Poor	Very poor.
Poor	Fair	Fair	Fair [1]	Fair	Fair	Fair.
Poor	Very poor	Poor	Very poor	Fair	Poor	Very poor.
Poor	Fair	Fair	Fair [1]	Fair	Very poor	Fair.
Fair	Poor	Fair	Poor [1]	Fair	Fair	Fair.
Poor	Fair	Fair	Fair [1]	Fair	Fair	Fair.
Poor	Very poor	Poor	Fair	Good	Poor	Very poor.
Poor	Very poor	Very poor	Fair	Good	Poor	Very poor.
Poor	Very poor	Very poor	Fair	Good	Poor	Very poor.
Poor	Very poor	Very poor	Poor [1]	Fair	Fair	Very poor.
Poor	Poor	Fair	Fair [1]	Good	Poor	Poor.
Poor	Poor	Fair	Fair [1]	Fair	Poor	Poor.
Poor	Very poor	Very poor	Fair	Good	Very poor	Very poor.
Poor	Very poor	Very poor	Fair	Good	Poor	Very poor.
Poor	Very poor	Poor	Fair [1]	Good	Fair	Very poor.
Poor	Very poor	Very poor	Poor [1]	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Very poor	Good	Poor	Very poor.

TABLE 3.—*Suitability of the soils for elements of*

Soil series and map symbols	Elements of wildlife habitat: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Woody plants: Hardwoods
Quinlan:				
QwC	Poor	Fair	Fair	Very poor
For Woodward part, refer to Woodward series.				
QwE	Very poor	Poor	Fair	Very poor
For Woodward part, refer to Woodward series.				
Reinach: Ra	Good	Good	Good	Poor
Renfrow: RcA	Good	Good	Good	Very poor
Ruella: RuA	Good	Good	Good	Poor
Salorthids: Sa	Very poor	Very poor	Very poor	Very poor
Shellabarger: ShB	Good	Good	Good	Poor
Tabler: TaA	Good	Good	Good	Very poor
Tivoli: Tr	Poor [2]	Poor	Poor	Very poor
Woodward: WuB	Good	Good	Good	Very poor
For Quinlan part, refer to Quinlan series.				
Yahola:				
Ya	Fair	Good	Good	Fair
Yp	Poor	Fair	Fair	Fair
For Port part, refer to Port series.				

[1] Rating applies where soil is used for a pond reservoir area.

A rating of *good* means that the soil is well suited or is above average in suitability and that a suitable habitat generally is easily created, improved, or maintained on the soil. Few or no soil limitations affect management, and satisfactory results can be expected if the soil is used for the prescribed purpose.

A rating of *fair* means that the soil is suited to use for wildlife habitat or is about average in suitability and that a suitable wildlife habitat can be created, improved, or maintained in most places. The soils have moderate limitations that affect management. Moderate intensity of management and fairly frequent attention may be required to assure satisfactory results.

A rating of *poor* means that the soil is poorly suited to use for wildlife habitat or is below average in suitability but that in most places a suitable habitat can be created, improved, or maintained. Soil limitations affecting management of the habitat are severe, and management of the habitat is difficult and requires intensive effort. Results are uncertain.

A rating of *very poor* means that creating, improving, or maintaining a suitable habitat is impossible or is not feasible under prevailing conditions. Unsatisfactory results are probable.

Habitat elements

The eight habitat elements listed in table 3 are described in the following paragraphs.

Grain and seed crops.—These are seed-producing annuals, including agricultural grains planted to produce food for wildlife. Examples are corn, sorghum, millet, and soybeans.

Grasses and legumes.—These are domestic perennial grasses and herbaceous legumes that are established by planting and that furnish food and cover for wildlife. Examples are bahiagrass, ryegrass, panicgrass, annual lespedeza, shrub lespedeza, and clover.

Wild herbaceous plants.—These are native or introduced perennial grasses and forbs (weeds) that provide food and cover mainly for upland forms of wildlife and that are established mainly through natural processes. Examples are beggarweed, perennial lespedeza, wild bean, pokeweed, and cheatgrass. Of plants that grow on the range, examples are bluestem, grama, and perennial forbs and legumes.

Hardwood woody plants.—These are nonconiferous trees, shrubs, and vines that produce fruit, nuts,

wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued				Kinds of wildlife		
Woody plants—Continued: Conifers	Wetland food and cover plants	Shallow water developments	Ponds	Openland	Woodland	Wetland
Fair	Very poor	Very poor	Poor	Fair	Very poor	Very poor.
Fair	Very poor	Very poor	Poor	Poor	Very poor	Very poor.
Poor	Very poor	Fair	Poor	Good	Poor	Very poor.
Poor	Very poor	Fair	Fair	Good	Very poor	Very poor.
Poor	Very poor	Fair	Poor	Good	Poor	Very poor.
Very poor	Very poor	Fair	Poor [1]	Very poor	Very poor	Poor.
Poor	Very poor	Poor	Poor	Good	Poor	Very poor.
Poor	Very poor	Poor	Fair [1]	Good	Very poor	Very poor.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
Poor	Very poor	Poor	Fair	Good	Very poor	Very poor.
Poor	Very poor	Poor	Poor	Good	Fair	Very poor.
Fair	Very poor	Poor	Poor [1]	Fair	Fair	Very poor.

[1] Very poor where slope exceeds 25 percent.

catkins, buds, twigs, or foliage used entensively as food by wildlife. They are commonly established through natural processes, but they may be planted. Examples are oak, beech, cherry, dogwood, maple, viburnum, grape, honeysuckle, greenbrier, and silverberry.

Coniferous woody plants.—These are coniferous trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds, or fruitlike cones or berries. These plants are commonly established through natural processes, but they may be planted and managed. Examples are pine, juniper, and ornamental coniferous trees and shrubs.

Wetland food and cover plants.—These are annual and perennial wild, herbaceous plants growing on moist and wet sites. They produce food and cover mainly for wetland wildlife. Examples are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema.

Shallow water developments.—These are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create a habitat that is suitable for waterfowl. Some of these developments are designed to be drained, planted, and then flooded. Others are permanent impoundments in which submersed aquatic plants are grown.

Ponds.—These are dugout areas or a combination of dugout areas and low dikes or dams that contain water in suitable quality and depth to support the production of fish.

Kinds of wildlife

The kinds of wildlife for which ratings are given in table 3 are described as follows.

Openland wildlife consists of birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Examples are quail, doves, meadowlarks, field sparrows, cottontail rabbits, and foxes.

Woodland wildlife consists of birds and mammals that normally live in wooded areas made up of hardwood trees, coniferous trees, and shrubs. Examples are woodcocks, thrushes, wild turkey, vireos, deer, squirrels, and raccoons.

Wetland wildlife consists of birds and mammals that normally live in marshes, swamps, and other wet areas. Examples are ducks, geese, rails, shore birds, herons, minks, and muskrats.

Engineering Uses of the Soils [6]

This section is useful to those who need information about soils used as structural material or as foundation material upon which structures are built. Among those who can benefit from this section are planning commissioners, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficabiltiy of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4, 5 and 6, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples. This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in table 5, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meanings to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering soil classification systems

Soils are classified for various purposes, but mainly for farming and for engineering. The system used by the U.S. Department of Agriculture is primarily for agricultural use. It is helpful to engineers, however, because it classifies soil material according to texture. Of primary importance in this system is the relative proportion of the various-sized individual grains in a mass of soil. The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*8*) used by engineers of the Soil Conservation Service, Department of Defense, and others, and the AASHO system, adopted by the American Association of State Highway Officials (*1*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 6. The estimated classification without group index numbers, is given in table 4 for all soils mapped in the survey area.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are given in table 4. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kind of soil in other counties.

Depth to bedrock refers to distance from the surface of the soil to the upper surface of the underlying rock.

Depth to seasonal high water table refers to distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

[6] By GENE BOLLINGER and ERNEST HARDESTY, engineers, Soil Conservation Service.

Soil texture is described in table 4 in the standard terms used by the U.S. Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," or some of the other terms in USDA textural classification are defined in the Glossary. The coarse fraction greater than 3 inches in diameter is not listed in table 4, because all soils in this county lack a coarse fraction greater than 3 inches in diameter. The AASHO designations for texture are based on interim specifications published in 1968 (*2*).

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil material changes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 4. In table 6 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts. These estimated values should not be confused with the coefficient "K" of permeability, as used by engineers.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for production of crops. It also affects the stability of a soil that is used as material for construction, and it affects the corrosiveness of a soil in contact with metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table 4, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate in the soil, but also by soil mixture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a slight probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel, and more resistant concrete, should be used to avoid or minimize damage.

Engineering interpretations of the soils

The estimated interpretations in table 5 are based on the engineering properties of soils shown in table 4, on test data for soils in this survey area and in other areas nearby or adjoining, and on the experience of engineers and soil scientists who have knowledge of the soils of Alfalfa County. Table 5 gives ratings that summarize limitations or suitability of the soils for all the listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For those particular uses, table 5 indicates soil features that affect suitability of the soils for the specified use.

Soil limitations are indicated by the ratings slight, moderate, and severe. A rating of *slight* means that soil properties are generally favorable for the rated use, or in other words, limitations are minor and are easily overcome, or they can be modified by special planning and design. A rating of *moderate* means that some properties are unfavorable but that they can be overcome by special planning or design. A rating of *severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms of "good," "fair," "poor," and "unsuited," which have, respectively, meanings approximately parallel to the terms "slight," "moderate," "severe," and "very severe." Following are explanations of some of the columns in table 5.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to a depth of 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

TABLE 4.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil, which may column of this table. The symbol >

Soil series and map symbols	Depth to— Bed-rock	Depth to— Season-al high water table	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO [1]
	In	*In*	*In*			
*Albion: AbA, AbB, AbC, AbE, AgC, AgC2, AgD2. For Grant part of AgC, AgC2, and AgD2, refer to Grant series.	>72	>72	0-8	Sandy loam, loam	SM or ML	A-4
			8-32	Sandy loam, loam	SM, ML, CL-ML or SM-SC	A-4
			32-75	Gravelly sand, sand	SM or SP-SM	A-2 or A-1
*Aline: AlB, AnE. For Tivioli part of AnE, refer to Tivoli series.	>72	>72	0-34	Fine sand	SM or SP-SM	A-2 or A-3
			34-72	Fine sand, loamy fine sand.	SM or SP-SM	A-2 or A-3
Attica: AsB, AtB, AtC	>72	>72	0-16	Fine sandy loam, loamy fine sand.	SM or SM-SC	A-2 or A-3
			16-44	Fine sandy loam, loam, sandy loam.	SM, ML, SM-SC, or CL-ML	A-4
			44-65	Loam, silt loam	ML or CL	A-4 or A-6
*Brewer: [5] Br	>72	>72	0-20	Silt loam	CL or ML	A-4 or A-6
			20-52	Silty clay loam, clay loam.	CL or CH	A-6 or A-7
			52-75	Silty clay loam, clay, loam, silt loam.	CL or ML	A-4, A-6 or A-7
Bu. For Drummond part, refer to Drummond series.	>72	>50	0-20	Silt loam	CL or ML	A-4 or A-6
			20-52	Silty clay loam, clay loam.	CL or CH	A-6 or A-7
			52-75	Silty clay loam, clay, loam, silt loam.	CL or ML	A-4, A-6 or A-7
*Carwile: CaB. For Attica part, refer to Attica series.	>72	0-12	0-12	Loam, fine sandy loam	SM-SC, CL-ML, SC, or CL	A-4 or A-6
			12-38	Clay loam, clay, sandy clay.	CL or CH	A-6 or A-7
			38-42	Clay loam, sandy clay loam, sandy clay.	CL	A-6, A-4, or A-7
			42-60	Loam, fine sandy loam	SM-SC, SC, CL-ML, or CL	A-4 or A-6
Crisfield: Cr [5]	>72	>72	0-14	Fine sandy loam	SM, ML, SM-SC, or CL-ML	A-4
			14-44	Fine sandy loam, loam	SM, ML, SM-SC, or CL-ML	A-4
			44-75	Very fine sandy loam, fine sandy loam, loam.	SM, ML, SM-SC, or CL-ML	A-4
Dale: [5] DaA, DlD	>72	>72	0-8	Silt loam, silty clay loam.	CL or CL-ML	A-4 or A-6
			8-22	Silt loam	CL or CL-ML	A-4 or A-6
			22-35	Silt loam, silty clay loam.	CL or CL-ML	A-4 or A-6
			35-64	Silt loam	CL or CL-ML	A-4 or A-6
De	>72	>72	0-35	Silt loam	CL or CL-ML	A-4 or A-6
			35-64	Silt loam	CL or CL-ML	A-4 or A-6
Dillwyn: Dm	>72	15-60	0-70	Loamy fine sand	SM	A-2

See footnotes at end of table.

significant to engineering

have different properties. For this reason the reader should follow carefully the instructions for referring to another series listed in the first means more than; < means less than]

Percentage less than 3 inches in diameter passing sieve [2]—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity [3]	Shrink-swell potential	Corrosivity potential for—	
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete
					In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*			
98–100	80–100	36–70	<35	[4] NP–7	2. 0–6. 0	0. 10–0. 20	5. 6–6. 5	--------	Low	Low	Low.
98–100	80–100	36–70	<26	NP–6	2. 0–6. 0	0. 10–0. 20	6. 1–7. 8	--------	Low.		
60–90	40–60	10–30	--------	NP	2. 0–6. 0	0. 02–0. 06	6. 6–8. 4	--------	Low.		
98–100	65–85	10–20	--------	NP	6. 0–20. 0	0. 05–0. 08	5. 6–7. 3	--------	Low	Low	Moderate.
98–100	60–80	10–35	--------	NP	6. 0–20. 0	0. 05–0. 11	5. 6–7. 3	--------	Low.		
94–100	55–98	15–50	<15	NP–4	2. 0–6. 0	0. 07–0. 15	6. 1–7. 3	--------	Low	Low	Low.
98–100	94–100	36–70	<25	NP–7	2. 0–6. 0	0. 10–0. 20	6. 1–7. 3	--------	Low.		
100	96–100	65–97	20–30	1–15	2. 0–6. 0	0. 15–0. 24	6. 6–8. 4	--------	Low.		
100	96–100	80–97	21–38	1–16	0. 6–2. 0	0. 16–0. 24	6. 1–7. 3	--------	Low	High	Low.
100	96–100	75–98	35–55	25–40	0. 06–0. 20	0. 15–0. 20	7. 4–8. 4	[6] 0–8	High.		
100	96–100	75–98	30–50	7–25	0. 06–2. 0	0. 09–0. 18	7. 9–8. 4	0–8	Moderate.		
100	96–100	80–97	21–38	1–16	0–6–2. 0	0. 16–0. 24	6. 1–7. 3	--------	Low	Very high	Moderate or high.
100	96–100	75–98	35–55	25–40	0. 06–0. 20	0. 15–0. 20	7. 4–8. 4	[6] 8–16	High.		
100	96–100	75–98	30–50	7–25	0. 06–2. 0	0. 09–0. 18	7. 9–8. 4	8–16	Moderate.		
98–100	94–100	36–85	20–35	4–15	0. 6–2. 0	0. 11–0. 20	5. 6–7. 3	--------	Low	High	Moderate.
98–100	96–100	65–90	35–55	20–35	0. 06–0. 20	0. 15–0. 20	5. 6–8. 4	--------	Moderate.		
100	90–100	51–90	30–50	10–30	0. 06–0. 20	0. 12–0. 20	7. 4–8. 4	--------	Low to moderate.		
98–100	94–100	36–85	20–35	4–15	0. 6–2. 0	0. 11–0. 20	7. 9–8. 4	--------	Low.		
98–100	94–100	36–60	<25	NP–6	2. 0–6. 0	0. 11–0. 15	6. 1–7. 3	--------	Low	Low	Low.
98–100	94–100	36–70	<25	NP–7	2. 0–6. 0	0. 11–0. 20	6. 1–7. 3	--------	Low.		
98–100	94–100	36–70	<25	NP–7	2. 0–6. 0	0. 11–0. 20	7. 4–8. 4	--------	Low.		
100	96–100	80–97	25–40	5–15	0. 6–2. 0	0. 16–0. 24	6. 6–7. 8	--------	Low	Moderate	Low.
100	96–100	80–96	21–38	5–19	0. 6–2. 0	0. 16–0. 24	6. 6–8. 4	--------	Low.		
98–100	96–100	80–98	25–40	5–26	0. 6–2. 0	0. 16–0. 24	7. 4–8. 4	--------	Moderate.		
100	96–100	80–96	21–38	5–19	0. 6–2. 0	0. 08–0. 18	7. 9–8. 4	--------	Low.		
100	96–100	80–96	21–38	5–19	0. 6–2. 0	0. 16–0. 24	6. 6–8. 4	--------	Low	High or very high.	Moderate or severe.
100	96–100	80–96	21–38	5–19	0. 6–2. 0	0. 08–0. 18	7. 9–8. 4	[6] 8–16	Low.		
98–100	85–100	15–35	--------	NP	6. 0–20. 0	0. 07–0. 11	6. 1–7. 8	--------	Low	Moderate	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO [1]
Dougherty: DoB	>72	>72	0–24	Fine sand	SM or SP–SM	A–2 or A–3
			24–62	Sandy clay loam, fine sandy loam.	SM, SC, CL–ML, ML or CL	A–4
			62–75	Fine sand, fine sandy loam.	SM, SM–SC, ML, CL–ML, or SP–SM	A–2, A–3, or A–4
*Drummond: [5] DrB, DtB. For Pratt part of DtB, refer to Pratt series.	>72	24–120	0–8	Silt loam, loam, fine sandy loam.	SM, ML, CL–ML, or CL	A–4 or A–6
			8–48	Clay loam, silty clay loam, clay.	CL or CH	A–7
			48–62	Stratified, variable.		
Goltry: GoB	>72	30–80	0–30	Fine sand	SM	A–2 or A–3
			30–72	Fine sand, loamy fine sand.	SM	A–2
Gracemont: [5] Gp	>72	<40	0–28	Fine sandy loam, loam	SM, ML, CL–ML, or SM–SC	A–4
			28–60	Fine sand, fine sandy loam.	SM or SM–SC	A–2, A–4, or A–3
*Grant: GrB, GrC, GrC2, GtD2, GuE. For Nash part of GtD2 and Port part of GuE, refer to those series.	>72	>72	0–16	Silt loam, loam	ML, CL–ML, or CL	A–4
			16–52	Silty clay loam, silt loam	CL or ML	A–4, A–6 or A–7
			52–75	Silt loam	ML, CL–ML, or CL	A–4 or A–6
Lincoln: [5] Ls	>72	>60	0–8	Loamy fine sand, fine sandy loam.	SM or SC	A–2 or A–4
			8–65	Fine sand, loamy fine sand.	SM or SP–SM	A–2 or A–3
McLain: [5] Mc	>72	>72	0–20	Silt loam	CL, CL–ML, or ML	A–4 or A–6
			20–52	Silty clay loam, clay loam.	CL	A–6 or A–7
			52–75	Silty clay loam, silt loam, clay loam.	CL, CL–ML, or ML	A–4, A–6 or A–7
Miller: [5] Mr	>72	>72	0–16	Clay	CL, CH or MH	A–7
			16–33	Clay, clay loam, silty clay loam.	CL, CH or MH	A–6 or A–7
			33–50	Clay, silty clay loam	CL, CH or MH	A–6 or A–7
			50–75	Silt loam, clay loam, clay, silty clay loam.	CL, CH or MH	A–6 or A–7
Nash. Mapped only with Grant soils in GtD2.	20–40	>72	0–30	Silt loam, loam	CL, CL–ML, or ML	A–4 or A–6
			30–40	Sandstone.		
Pond Creek: PcA, PcB	>72	>72	0–17	Silt loam	CL, CL–ML, or ML	A–4 or A–6
			17–68	Silty clay loam, silt loam.	CL or ML	A–4, A–6 or A–7
Port: [5] Pr	>72	>72	0–75	Silt loam, loam, silty clay loam.	CL, CL–ML, or ML	A–4, A–6 or A–7
Pratt: PtB, PtC	>72	>72	0–75	Loamy fine sand	SM	A–2 or A–3

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches in diameter passing sieve [2]—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity [3]	Shrink-swell potential	Corrosivity potential for—	
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete
					In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C.*			
98–100	82–98	10–20	--------	NP	2. 0–6. 0	0. 05–0. 08	6. 1–6. 5	--------	Low	Low	Moderate.
98–100	90–100	36–65	20–30	NP–10	0. 6–2. 0	0. 11–0. 17	6. 1–6. 5	--------	Low.		
98–100	82–100	10–60	<20	NP–6	2. 0–6. 0	0. 05–0. 15	6. 1–7. 3	--------	Low.		
98–100	90–100	36–97	20–35	NP–15	0. 6–6. 0	0. 12–0. 16	6. 1–7. 8	8–20	Low	Very high	High.
100	90–100	80–98	45–55	25–35	<0. 06	0. 15–0. 19	7. 4–8. 4	8–20	Moderate to high.		
98–100	82–98	10–25	--------	NP	6. 0–20. 0	0. 05–0. 08	6. 1–7. 3	--------	Low	Moderate	Low or moderate.
98–100	90–100	15–35	--------	NP	2. 0–6. 0	0. 05–0. 10	6. 1–8. 4	--------	Low.		
98–100	94–100	36–70	<26	NP–6	2. 0–6. 0	0. 08–0. 15	7. 9–8. 4	8–16	Low	Very high	Moderate or high.
98–100	82–98	15–40	<15	NP–6	2. 0–6. 0	0. 08–0. 15	7. 9–8. 4	8–16	Low.		
100	94–100	65–97	20–30	1–10	0. 6–2. 0	0. 15–0. 24	6. 1–7. 3	--------	Low	Moderate	Low.
100	96–100	80–98	21–50	10–21	0. 6–2. 0	0. 16–0. 24	6. 1–8. 4	--------	Moderate		
100	94–100	80–98	24–37	1–15	0. 6–2. 0	0. 16–0. 24	7. 4–8. 4	--------	Low.		
98–100	90–100	15–45	--------	NP	6. 0–20. 0	0. 07–0. 15	7. 9–8. 4	--------	Low	Very low	Low.
98–100	82–98	10–35	--------	NP	6. 0–20. 0	0. 05–0. 11	7. 9–8. 4	--------	Low.		
100	96–100	80–97	21–37	1–14	0. 6–2. 0	0. 16–0. 24	6. 1–7. 3	--------	Low	High	Low.
100	96–100	75–98	33–50	13–26	0. 06–0. 20	0. 15–0. 22	6. 6–8. 4	--------	Moderate.		
100	96–100	75–98	21–50	1–26	0. 06–0. 20	0. 15–0. 24	7. 9–8. 4	--------	Low or moderate.		
100	96–100	90–98	45–65	25–40	<0. 06	0. 12–0. 18	6. 6–8. 4	--------	High	High	Low.
100	96–100	75–98	35–65	20–40	<0. 06	0. 12–0. 22	7. 9–8. 4	--------	High.		
100	96–100	90–98	35–65	20–40	<0. 06	0. 12–0. 22	7. 9–8. 4	--------	High.		
100	96–100	75–98	21–65	15–40	<0. 06	0. 12–0. 24	7. 9–8. 4	--------	High.		
100	96–100	65–98	21–37	1–15	0. 6–2. 0	0. 15–0. 24	6. 6–8. 4	--------	Low	Low	Low.
100	96–100	80–98	21–37	1–15	0. 6–2. 0	0. 16–0. 24	6. 1–7. 3	--------	Low	Moderate	Low.
100	96–100	80–98	24–49	8–26	0. 2–0. 6	0. 16–0. 24	6. 1–8. 4	--------	Moderate.		
100	96–100	75–98	21–50	1–26	0. 6–2. 0	0. 15–0. 24	6. 6–8. 4	--------	Low or moderate.	Low	Low.
98–100	85–95	15–35	--------	NP	6. 0–20. 0	0. 07–0. 11	5. 6–7. 3	--------	Low	Low	Low or moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO [1]
*Quinlan: QwC, QwE For Woodward part, refer to Woodward series.	10–20	>72	0–16 16	Silt loam, loam, silty clay loam. Sandstone.	ML, CL–ML, or CL	A–4 or A–6
Reinach:[5] Ra	>72	>72	0–75	Very fine sandy loam, silt loam.	ML, CL–ML, or CL	A–4
Renfrow: RcA	>60	>72	0–8	Silt loam	CL, CL–ML, or ML	A–4 or A–6
			8–14	Silty clay loam	CL, CH	A–6 or A–7
			14–65	Silty clay, silty clay loam, clay.	CL or CH	A–6 or A–7
Ruella: RuA	>72	>72	0–75	Loam	CL, CL–ML, or ML	A–4 or A–6
Salorthids: Sa. Too variable for valid estimates.						
Shellabarger: ShB	>72	>72	0–16	Fine sandy loam	SM, CL–ML, ML, or SM–SC	A–4
			16–42	Sandy clay loam	SC or CL	A–4 or A–6
			42–52	Sandy clay loam, fine sandy loam.	SC, SM, ML or CL	A–4 or A–6
			52–66	Fine sandy loam	SM, CL–ML, ML, or SM–SC	A–4
Tabler: TaA	>72	>72	0–10	Silty clay loam	CL	A–6 or A–7
			10–48	Silty clay, clay	CL or CH	A–7
			48–70	Silty clay loam, clay	CL or CH	A–6 or A–7
Tivoli: Tr	>72	>72	0–75	Fine sand	SM or SP–SM	A–2 or A–3
*Woodward: WuB For Quinlan part, refer to Quinlan series.	20–48	>72	0–27 27–34	Silt loam, loam, very fine sandy loam. Sandstone.	CL–ML or CL	A–4
*Yahola:[5] Ya, Yp For Port part of Yp, refer to Port series.	>72	>60	0–75	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL–ML, or SM–SC	A–4

[1] Based on AASHO Designation: M145–66I, *in* Interim Specifications and Methods adopted by the AASHO Committee on Materials 1966–67 (*2*).
[2] 100 percent of all soils passed the No. 4 sieve, except those of the Albion series, 32–75 inch layer. For Albion soils in the 32–75 inch layer, 70 to 90 percent passed the No. 4 sieve.

significant to engineering—Continued

Percentage less than 3 inches in diameter passing sieve [2]— No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Liquid limit	Plasticity index	Permeability	Available water cavacity	Reaction	Salinity [3]	Shrink-swell potential	Corrosivity potential for— Uncoated steel	Concrete
					In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C.*			
100	96–100	65–98	21–40	1–20	2. 0–6. 0	0. 15–0. 24	7. 4–8. 4	--------	Low or moderate.	Low-------	Low.
100	94–100	50–97	<20	NP–10	0. 6–2. 0	0. 13–0. 24	6. 6–8. 4	--------	Low-------	Low-------	Low.
100	96–100	80–97	21–37	1–14	0. 6–2. 0	0. 16–0. 24	6. 1–7. 3	--------	Low-------	High-------	Low.
100	96–100	90–98	40–52	20–31	0. 2–0. 6	0. 15–0. 22	6. 6–7. 8	--------	Moderate.		
100	96–100	90–99	45–60	25–40	<0. 06	0. 12–0. 22	6. 6–8. 4	--------	High.		
100	96–100	65–98	22–36	2–15	0. 6–2. 0	0. 15–0. 20	7. 9–8. 4	--------	Low-------	Low-------	Low.
98–100	95–100	36–60	<26	NP–6	2. 0–6. 0	0. 11–0. 15	5. 6–6. 5	--------	Low-------	Moderate---	Low.
98–100	90–100	36–65	25–35	8–15	0. 6–2. 0	0. 12–0. 17	6. 1–7. 8	--------	Low.		
98–100	90–100	36–65	<30	NP–15	0. 6–6. 0	0. 11–0. 17	6. 6–8. 4	--------	Low.		
98–100	94–100	36–60	NP–26	NP–6	2. 0–6. 0	0. 11–0. 15	6. 6–8. 4	--------	Low.		
100	98–100	90–98	35–50	13–26	0. 2–0. 6	0. 18–0. 22	6. 1–7. 3	--------	Moderate---	High-------	Low.
100	96–100	90–99	45–60	20–35	<0. 06	0. 12–0. 18	6. 6–8. 4	--------	High.		
100	96–100	90–98	40–60	15–35	<0. 06	0. 12–0. 22	7. 9–8. 4	--------	Moderate to high.		
98–100	82–98	10–20	--------	NP	6. 0–20. 0	0. 05–0. 11	6. 1–7. 8	--------	Low-------	Low-------	Low.
100	94–100	50–90	20–30	4–10	0. 6–2. 0	0. 13–0. 24	6. 6–8. 4	--------	Low-------	Low-------	Low.
98–100	94–100	36–70	<26	NP–6	2. 0–6. 0	0. 07–0. 20	7. 9–8. 4	--------	Low-------	Low-------	Low.

[3] Values are based on electrical conductivity of the saturation extract and have the following meanings for salinity class: Less than 2.0, none; 2.0–4.0, low; 4.0–8.0, moderate; 8.0–16.0, high; more than 16.0, very high.

[4] NP means nonplastic.

[5] Subject to flooding.

[6] Below depth of 40 inches.

TABLE 5.—*Interpretations of engineering*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil, which may in the first column

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without a basement	Sanitary land fill [1] (trench)	Local roads and streets
*Albion:						
AbA, AbB, AbC, AgC, AgC2, AgD2. For Grant part of AgC, AgC2, and AgD2, see Grant series.	Slight	Severe: excessive permeability.	Moderate: too sandy.	Slight or moderate: low strength.	Severe: excessive permeability.	Moderate: low strength.
AbE	Moderate: slope.	Severe: excessive permeability.	Moderate: slope; too sandy.	Moderate: slope; low strength.	Severe: excessive permeability.	Moderate: low strength.
*Aline:						
AlB	Slight	Severe: excessive permeability.	Severe: too sandy.	Severe: low strength.	Severe: excessive permeability.	Slight
AnE. For Tivoli part, see Tivoli series.	Moderate: slope.	Severe: excessive permeability.	Severe: slope; too sandy.	Severe: low strength.	Severe: excessive permeability.	Slight
Attica: AsB, AtB, AtC.	Slight	Severe: excessive permeability.	Moderate: too sandy.	Slight	Severe: excessive permeability.	Moderate: low strength.
*Brewer: Br, Bu. For Drummond part of Bu, see Drummond series.	Severe: restrictive permeability.	Slight: rare flooding.	Moderate: wetness; rare flooding; too clayey.	Severe: rare flooding.	Severe: too clayey.	Severe: expansive; low strength.
*Carwile: CaB. For Attica part, see Attica series.	Severe: restrictive permeability; wetness.	Slight	Severe: wetness.	Severe: wetness.	Moderate: too clayey.	Severe: wetness; low strength.
Crisfield: Cr	Severe: rare flooding.	Severe: excessive permeability.	Severe: rare flooding.	Severe: rare flooding.	Severe: rare flooding; excessive permeability.	Moderate: rare flooding; low strength.
Dale:						
DaA	Moderate: flooding.	Moderate: excessive permeability.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding; low strength.
De	Moderate: flooding.	Moderate: excessive permeability.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: low strength; flooding.

See footnote at end of table.

properties of the soils

have different properties and limitations. For this reason the reader should follow carefully the instructions for referring to another series of this table]

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces and diversions
Fair: low strength.	Poor for sand; unsuitable for gravel.	Good	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained or somewhat excessively drained.	Slope; moderately rapid infiltration.	Features favorable.
Fair: low strength.	Poor for sand; unsuitable for gravel.	Fair: slope	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained or somewhat excessively drained.	Slope; moderately rapid infiltration.	Slope.
Good	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage.	Excessive seepage; piping.	Not applicable; somewhat excessively drained.	Rapid infiltration; droughtiness.	Not applicable; complex slope.
Good	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage.	Excessive seepage; piping.	Not applicable; somewhat excessively drained.	Rapid infiltration; slope; droughtiness.	Not applicable; complex slope.
Fair: low strength.	Unsuitable	Good if fine sandy loam; poor if loamy fine sand.	Excessive seepage.	Excessive seepage; unstable slopes.	Not applicable; well drained.	Moderately rapid infiltration; erodible.	Slope.
Poor: low strength; expansive.	Unsuitable	Good	Features favorable.	Unstable slopes.	Not applicable; moderately well drained.	Features favorable.	Not applicable; nearly level
Poor: low strength.	Unsuitable	Fair: thin layer.	Seasonal perched water table.	Unstable slopes.	Somewhat poorly drained; water table at depth of 0 to 1 foot; wet areas lower than available outlets.	Not applicable; somewhat poorly drained.	Not applicable; nearly level.
Fair: low strength.	Unsuitable	Good	Excessive seepage.	Excessive seepage; piping.	Not applicaable; well drained.	Moderately rapid infiltration.	Not applicable; nearly level.
Poor: low strength.	Unsuitable	Good	Excessive seepage	Unstable slopes.	Not applicable; well drained.	Features favorable.	Not applicable; nearly level.
Poor: low strength.	Unsuitable	Fair: too clayey.	Excessive seepage.	Unstable slopes.	Not applicable; well drained.	Salinity	Not applicable; nearly level.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without a basement	Sanitary land fill [1] (trench)	Local roads and streets
Dale—Continued DlD	Moderate: flooding.	Moderate: excessive permeability; slope.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding; slope; low strength.
Dillwyn: Dm	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Dougherty: DoB	Slight	Moderate: excessive permeability.	Slight	Slight	Slight	Moderate: low strength.
*Drummond: DrB, DtB. For Pratt part of DtB, see Pratt series.	Severe: restricted permeability; wetness.	Severe: wetness.	Severe: wetness.	Severe: expansive; flooding.	Severe: wetness.	Severe: expansive; low strength.
Goltry: GoB	Moderate: wetness.	Severe: wetness.	Severe: too sandy; wetness.	Slight	Severe: wetness.	Slight
Gracemont: Gp	Severe: wetness; frequent flooding.	Severe: wetness; frequent flooding.	Severe: wetness; frequent flooding.	Severe: frequent flooding; wetness.	Severe: frequent flooding; wetness.	Severe: frequent flooding.
*Grant: GrB, GrC, GrC2, GtD2, GuE. For Nash part of GtD2 and Port part of GuE, see those series.	Moderate: restrictive perpermeability.	Moderate if slopes are 1 to 7 percent; severe if slopes are 7 to 12 percent.	Slight if slopes are 1 to 8 percent; moderate if slopes are 8 to 12 percent.	Moderate: expansive.	Moderate: too clayey.	Severe: low strength.
Lincoln: Ls	Severe: frequent flooding.	Severe: excessive permeability; frequent flooding.	Severe: frequent flooding: too sandy.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
McLain: Mc	Severe: restrictive permeability.	Slight: rare flooding.	Severe: wetness; rare flooding.	Severe: rare flooding.	Severe: too clayey.	Severe: low strength.

See footnote at end of table.

properties of the soils—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: low strength.	Unsuitable	Good	Excessive seepage.	Unstable slopes.	Not applicable; well drained.	Slope; erodible	Short slopes.
Fair: wetness.	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage above water table, which is at depth of 15 to 60 inches.	Excessive seepage; piping.	Seasonal high water table; somewhat poorly drained.	Seasonal high water table.	Not applicable; complex slopes.
Moderate: low strength.	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained.	Slope; suitable for sprinkler system.	Susceptible to soil blowing and siltation.
Poor: low strength; expansive.	Unsuitable	Poor: saline	Saline water table at depth of 24 to 120 inches.	Piping; unstable slopes.	Seasonal high water table; somewhat poorly drained; very slow permeability.	Moderately or strongly affected by salinity.	Not applicable; complex slopes.
Good	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage above water table, which is at depth of 30 to 80 inches.	Excessive seepage.	Not applicable; moderately well drained; water table at depth of 30 to 80 inches.	Moderate to low available water capacity; water table at depth of 30 to 80 inches.	Not applicable; little or no runoff.
Fair: wetness; low strength.	Unsuitable	Good	Excessive seepage above saline water table, which is at depth of 40 inches.	Excessive piping.	Seasonal high water table; somewhat poorly drained; flooding; salinity.	Moderately or strongly affected by salinity.	Not applicable; nearly level.
Poor: low strength.	Unsuitable	Good if slopes are 1 to 8 percent; fair if slopes are 8 to 12 percent.	Excessive seepage.	Excessive seepage; unstable slopes.	Not applicable; well drained.	Slope; erodibility.	Features favorable.
Good	Fair for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage; flooding.	Excessive seepage.	Not applicable; excessively drained; frequent flooding.	Low to moderate available water capacity; frequent flooding.	Not applicable; frequent flooding.
Poor: low strength.	Unsuitable	Good	Features favorable.	Unstable slopes.	Not applicable; moderately well drained.	Features favorable.	Not applicable; nearly level.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without a basement	Sanitary land fill [1] (trench)	Local roads and streets
Miller: Mr	Severe: restrictive permeability; occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: expansive; occasional flooding.	Severe: occasional flooding.	Severe: expansive; low strength; occasional flooding.
Nash. Mapped only with Grant soils.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock; low strength.
Pond Creek: PcA, PcB.	Severe: restrictive permeability.	Slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 3 percent.	Slight	Moderate: expansive.	Moderate: too clayey.	Severe: low strength.
Port: Pr	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: low strength; occasional or frequent flooding.
Pratt: PtB, PtC	Slight	Severe: excessive permeability.	Severe: too sandy.	Slight	Severe: excessive permeability.	Slight
*Quinlan: QwC, QwE. For Woodward part, see Woodward series.	Severe: depth to rock.	Severe: depth to rock.	Moderate if slopes are 1 to 15 percent; depth to rock; severe if slopes are 15 to 30 percent.	Moderate if slopes are 1 to 15 percent; depth to rock; severe if slopes are 15 to 30 percent.	Severe: depth to rock.	Moderate if slopes are 1 to 15 percent; depth to rock; low strength; severe if slopes are 15 to 30 percent.
Reinach: Ra	Moderate: rare flooding.	Moderate: excessive permeability.	Moderate: rare flooding.	Severe: rare flooding.	Moderate: rare flooding.	Moderate: rare flooding; low strength.
Renfrow: RcA	Severe: restrictive permeability.	Slight	Severe: too clayey.	Severe: expansive.	Severe: too clayey.	Severe: expansive; low strength.
Ruella: RuA	Slight	Moderate: excessive permeability.	Slight	Slight	Slight	Moderate: low strength.
Salorthids: Sa	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.

See footnote at end of table.

properties of the soils—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell; low strength.	Unsuitable	Poor: too clayey.	Features favorable where protected from flooding.	Unstable slopes.	Moderately well drained; flooding; very slow permeability.	Very slow intake rate; occasional flooding.	Not applicable; nearly level; occasional flooding.
Poor: thin layer.	Unsuitable	Good	Thin layer	Slope; piping	Not applicable; well drained.	Slope; erodibility.	Features favorable.
Poor: low strength.	Unsuitable	Good	Excessive seepage.	Unstable slopes; piping.	Not applicable; well drained.	Features favorable.	Features favorable.
Poor: low strength.	Unsuitable	Good if silt loam or loam; fair if silty clay loam or clay loam.	Excessive seepage; occasional or frequent flooding.	Unstable slopes.	Not applicable; well drained.	Occasional or frequent flooding.	Not applicable; nearly level; occasional or frequent flooding.
Good	Poor for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained.	Rapid intake rate; moderate available water capacity.	Not applicable; little or no runoff.
Poor: thin layer.	Unsuitable	Fair if slopes are 1 to 15 percent; poor if slopes are 15 to 30 percent.	Thin layer	Thin layer	Not applicable; well drained.	Slope; shallow rooting depth.	Depth to rock.
Fair: low strength.	Unsuitable	Good	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained.	Features favorable.	Not applicable; nearly level.
Poor: expansive; low strength.	Unsuitable	Fair: thin layer.	Features favorable.	Unstable slopes.	Not applicable; well drained; very slow permeability.	Very slow intake rate.	Dense clay subsoil.
Fair: low strength.	Unsuitable	Good	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained.	Features favorable.	Slopes of 0 to 2 percent.
Poor: low strength; wetness.	Unsuitable	Unsuitable: salinity.	Saline water table; flooding.	Salinity; piping; unstable slopes.	Not applicable; salt flats; flooding.	Not applicable; salt flats; wetness; flooding.	Not applicable; salt flats.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without a basement	Sanitary land fill[1] (trench)	Local roads and streets
Shellabarger: ShB	Slight	Moderate: excessive permeability.	Slight	Slight	Slight	Moderate: low strength.
Tabler: TaA	Severe: restrictive permeability.	Slight	Severe: too clayey.	Severe: expansive.	Severe: too clayey.	Severe: expansive; low strength.
Tivoli: Tr	Moderate if slopes are 5 to 15 percent; severe if slopes are 15 to 30 percent.	Severe: excessive permeability.	Severe: too sandy.	Moderate if slopes are 5 to 15 percent; severe if slopes are 15 to 30 percent.	Severe: excessive permeability; too sandy.	Moderate if slopes are 5 to 15 percent; severe if slopes are 15 to 30 percent.
*Woodward: WuB. For Quinlan part, see Quinlan series.	Severe: depth to rock.	Severe: depth to rock.	Moderate if slopes are 1 to 15 percent; depth to rock; severe if slopes are 15 to 30 percent.	Moderate if slopes are 1 to 15 percent; depth to rock; severe if slopes are 15 to 30 percent.	Moderate if slopes are 1 to 15 percent; depth to rock; severe if slopes are 15 to 30 percent.	Moderatei f slopes are 1 to 15 percent; low strength; severe if slopes are 15 to 30 percent.
*Yahola: Ya, Yp. For Port part of Yp, see Port series.	Severe: occasional or frequent flooding.	Severe: excessive permeability; occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: occasional or frequent flooding.	Severe: floodign.

[1] Onsite studies of the water table and underlying strata are needed to determine the hazards of pollution where land fills are deeper than 5 or 6 feet.

properties of the soils—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces and diversions
Fair: low strength.	Unsuitable	Fair: thin layer.	Excessive seepage.	Excessive seepage; piping.	Not applicable; well drained.	Features favorable.	Slopes of 1 to 3 percent.
Poor: expansive; low strength.	Unsuitable	Fair: too clayey; thin layer.	Features favorable.	Unstable slopes.	Not applicable; moderately well drained; very slow permeability.	Very slow intake rate.	Not applicable; nearly level.
Good	Fair for sand; unsuitable for gravel.	Poor: too sandy.	Excessive seepage.	Excessive seepage; piping; unstable slopes.	Not applicable; excessively drained.	Rapid intake rate; slope; low to moderate available water capacity.	Not applicable; little or no runoff.
Poor: thin layer.	Unsuitable	Good if slopes are 1 to 8 percent; fair if slopes are are 8 to 15 percent; poor if slopes are 15 to 30 percent.	Excessive seepage; bedrock at depth of 20 to 40 inches.	Unstable slopes; piping; thin layer.	Not applicable; well drained.	Moderate rooting depth; slope; erodibility.	Slopes.
Fair: low strength.	Unsuitable	Good if fine sandy loam, loam, or very fine sandy loam; poor if loamy fine sand.	Excessive seepage; flooding.	Excessive seepage; flooding.	Not applicable; well drained; occasional or frequent flooding.	Occasional or frequent flooding.	Not applicable; nearly level.

TABLE 6.—*Engineering*

Soil name and location	Parent material	Oklahoma report number SO—	Depth from surface	Shrinkage		Volume change from field moisture equivalent
				Limit	Ratio	
			In	*Pct*		
Dale silt loam:						
2,000 ft. E. of NW. corner of sec. 35, T. 26 N., R. 11 W. (Modal).	Loamy sediment.	432	0–22	23	1. 73	8
		433	32–54	15	1. 85	25
Grant silt loam:						
100 ft. E. of NW. corner of sec. 5, T. 25 N., R. 11 W. (Modal).	Sandstone, shale, or loamy sediment.	440	6–18	18	1. 77	20
		441	18–32	16	1. 84	36
		442	42–52	20	1. 71	18
Pond Creek silt loam:						
SW. corner of sec. 23, T. 24 N., R. 9 .W. (Modal).	Loamy sediment, sandstone, or shale.	434	7–17	18	1. 70	18
		435	26–39	13	1. 89	42
		436	39–60	12	1. 94	51
Reinach very fine sandy loam:						
200 ft. E. and 50 ft. S. of NW. corner of sec. 24, T. 28 N., R. 11 W. (Modal).	Loamy sediment.	455	7–18	[3] NP	NP	NP
		456	32–54	NP	NP	NP
Renfrow silt loam:						
600 ft. E. and 1,320 ft. N. of SW. corner of sec. 16, T. 24 N., R. 10 W. (Modal).	Shale or clayey sediment.	449	0–5	18	1. 71	17
		450	15–24	10	2. 02	50
		451	24–36	9	2. 05	53

[1] Particle sizes determined by mechanical analysis according to AASHO Designation T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet, long enough for bacteria to decompose the solids. A lagoon has a nearly level floor with sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and that the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, content of organic matter, and slope. If leveling of the floor is needed, depth to bedrock becomes important. Soil properties that affect the embankment are the engineering properties of the material used in the embankment, as interpreted from the Unified soil classification, and the amount of stones, if any, that influence the ease of excavation and the compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or of large stones, and freedom from flooding or a high water table.

Dwellings, as referred to in table 5, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support a load and to resistance to settlement under a load, and those that relate to ease of excavation. Soil properties that affect capacity to support a load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers. It is then compacted and covered with soil material throughout the disposal period. Areas used for landfill are subject to heavy vehicular traffic. Some soil properties that affect suitability of an area for landfill are ease of excavation, hazard of polluting the ground water, and trafficability. The best soils have moderately slow permeability, can withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 5 apply only to a depth of about 6 feet. Therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than 6 feet. For some soils, reliable predictions can be made to a depth of 10 to 15 feet, but every site should be investigated before it is selected.

Local roads and streets, as referred to in table 5, have an all-weather surface and can be expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material that has been stabilized with lime or

test data

Mechanical analysis [1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—					AASHO [2]	Unified
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm				
						Pct			
100	100	95	84	23	20	29	8	A-4(8)	ML-CL
100	100	94	83	32	27	38	19	A-6(12)	CL
100	100	97	86	25	22	30	9	A-4(8)	ML-CL
100	100	97	85	33	30	42	21	A-7-6(12)	CL
100	100	98	88	25	22	34	10	A-4(8)	ML-CL
100	100	98	85	24	20	32	10	A-4(8)	ML-CL
100	100	97	90	35	30	41	21	A-7-6(12)	CL
100	100	97	90	45	38	48	26	A-7-6(16)	CL
100	98	62	28	8	6	NP	NP	A-4(5)	ML
100	98	72	33	10	8	NP	NP	A-4(8)	ML
100	99	96	80	23	20	29	6	A-4(8)	ML-CL
100	100	98	89	47	42	52	28	A-7-6(17)	CH
100	99	97	82	50	44	54	31	A-7-6(19)	CH

and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.
[2] Based on AASHO Designation M 145-49 (*1*).
[3] Nonplastic.

cement; and a flexible or rigid surface, commonly of asphalt or concrete. These roads are graded so that they shed water, and they have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are the load-supporting capacity and stability of the material used for subgrade and the workability and quantity of the cut and fill material available. The AASHO and the Unified soil classifications of the soil material, and also the shrink-swell potential, indicate load-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. Ratings showing suitability of the soils for road fill reflect (1) the predicted performance of soil material that has been placed in an embankment and that has been properly compacted and provided with adequate drainage, and (2) the relative ease of excavating the material at the site of the borrow area.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 5 provide guidance about where to look for probable sources of this material. A soil rated as *good* as a source of sand or gravel generally has a layer of sand or gravel at least 3 feet thick, the top of which is within a depth of 6 feet from the soil surface. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the material. Neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; by natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are other characteristics that affect suitability. Also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among the factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and soil structure; depth to claypan, rock, or other layers that influence

rate of water movement; depth to the water table; slope; stability of the soil material in ditchbanks; susceptibility to stream overflow; and salinity or alkalinity. Availability of outlets is also important.

Irrigation of a soil is affected by such features as slope, susceptibility to stream overflow, past erosion and susceptibility to future water erosion or soil blowing, soil texture, content of stones, accumulations of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water, amount of water held available to plants, and need for drainage or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that the water soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. On a soil suitable for these structures, outlets for runoff are available and a cover of plants is not difficult to establish.

Engineering test data

Table 6 contains engineering test data for soils of some of the major series in Alfalfa County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material; the water content is expressed as a percentage of the weight of the soil material when ovendry.

The data on volume change indicate the amount of shrinkage and swelling that is obtained from samples prepared at optimum moisture content and then subjected to drying and wetting. The total change that can occur in a specified soil is the sum of the values given for shrinkage and for swelling.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as was explained for table 4.

Formation and Classification of the Soils

This section describes the major factors of soil formation and tells how these factors have affected the soils of Alfalfa County. It also briefly defines the system of soil classification currently used in the United States and shows the classification of the soil series by higher categories. The soil series in this county and a profile that is representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are the active factors of soil formation. They act on the parent material and slowly change it to a material that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the nature of the soil and determines some of the characteristics. Finally, time is needed to change the parent material into a soil profile. It may be much or little, but generally much time is required to develop a soil that has distinct horizons.

The five factors of soil formation are so closely interrelated in their effects on soils that few generalizations can be made. Differences in one or more of these factors, for example differences in climate or relief, result in the formation of different kinds of soils.

Parent material

Parent material is the weathered, unconsolidated material from which a soil forms. In many soils it is considered to be similar to the material in the C horizon. The color, texture, natural fertility, and other characteristics of the soil are affected by the parent material. As an example, the salinity of the Drummond and Gracemont soils, of the saline phase of the Dale soils, and of Salorthids is caused, in part, by the salts in the parent material. It is also caused by salts in the underground water from artesian springs that add salt to the soils below the soil surface.

The parent material of the soils of this county is of two main types. These are alluvial material and residual material that weathered from the underlying rocks. From 80 to 90 percent of the soils in the county formed, at least in part, in alluvial material. Examples of these are the Dale soils, the Pond Creek soils, and some of the Grant soils.

Most of the alluvial parent material was deposited during the Quaternary age. The Quaternary system is represented in this county by deposits of alluvium on flood plains along the major streams and by older, loamy and sandy deposits on uplands. The main soils that formed in alluvium on flood plains are those of the Gracemont, Lincoln, Port, and Yahola series. A large part of this alluvial material near the town of Cherokee and extending to the north sand east for several miles is 30 to 40 feet thick. The main soils that formed in the older, loamy and sandy deposits of Quaternary age, on uplands, are the Albion, Aline, Attica, Brewer, Dale, Pond Creek, and Pratt, as well as a large part of the acreage of the Grant soils.

Quinlan, Woodward, and some of the Grant soils formed in sediment of Permian age. Their parent material

was derived mostly from sandstone, but in some parts of the county, it was derived from shale.

Climate

The temperate, continental climate of Alfalfa County is characterized by rains of high intensity. In many of the soils, moisture and warm temperatures have been adequate for promoting the formation of distinct horizons. Most differences in the soils, however, cannot be attributed to differences in climate, because the climate is uniform throughout the county. An indirect effect of climate can be seen in some areas, where heavy rains have caused rapid runoff that, in turn, has caused erosion.

A more complete discussion of the climate of this county can be found under the heading "Climate" in the section "General Nature of the County."

Plant and animal life

Plants and animals are active in the formation of soils. Plants and micro-organisms grow in weathered parent material. They help to break down rock structure, and they produce organic residue. As this residue is produced and accumulates, an organically enriched layer, the A1 horizon, is formed. The A1 horizon gradually thickens until equilibrium with the other soil-forming processes is approached.

The A1 horizon is the most fertile part of the soil. It is the part with which man comes in direct contact when he plants and tills crops. The A1 horizon is also the layer in which bacteria, fungi, and other micro-organisms act to decompose organic matter, convert humus to simpler forms, liberate plant nutrients, and fix nitrogen. In that horizon earthworms and others of the larger organisms contribute to the translocation of plant residue, to the aeration of the soil, and to the development of soil structure. The thickness of the A1 horizon is regulated by the kind and amount of vegetation. Vegetation also has direct effect on the structure of that horizon.

Before the soils were first cultivated, the dominant vegetation in most parts of the county was tall and mid grasses. When the grasses died and decomposed, their residue darkened the A1 horizon of the Pond Creek, Grant, Dale, and similar soils. The grasses also strengthened the granular structure of the soils and improved the rate of infiltration.

Relief

Relief affects the formation of soils through its influence on moisture relations, drainage, erosion, temperature relations, and plant cover. Relief, or topography, can speed up or can retard the effects of the other soil-forming factors. As an example, much of the water from rainfall runs off of Quinlan and other steep soils. Consequently, geologic erosion nearly keeps pace with the weathering of rocks and with the formulation of a soil. On the Pond Creek and other nearly level soils, on the other hand, runoff is less rapid and the formation of the soil advances more rapidly. Thus, as a rule, the nearly level soils have a thicker, better developed profile than do steep soils.

Infiltration is more rapid and relief has less effect on the formation of sandy soils than where the soils are less porous. Thus, while relief is significant as a modifier of the effects of climate, its influence on the development of a soil profile depends on the factors of time, vegetation, and parent material.

Time

Time, as a factor in the formation of soils, cannot be measured strictly in years. The length of time necessary for a soil to develop genetic horizons depends on the intensity and interactions of the soil-forming factors that promote losses, gains, transfers, and interactions of soil constituents necessary for the formation of soil horizons. Soils that have no definite genetic horizons are considered to be young or immature. Mature, or older, soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils of Alfalfa County range from young to old. The Pond Creek and the Renfrow soils are among the oldest. They have a deeply developed profile and well-expressed horizons. In contrast, profiles of the Port and Yahola soils, on flood plains, have been developing for only a short time. They show little development of soil horizons.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and relationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*3*) and revised later (*5*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*4*) and was adopted in 1965 (*7*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 7 shows the classification of each soil series of Alfalfa County by family, subgroup, and order, according to the current system.

ORDER.—Ten soil orders are recognized in the current system. These are the Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different climates. Five of the soil orders are represented in Alfalfa County. These are the Alfisols, Aridisols, Entisols, Inceptisols, and Mollisols.

TABLE 7.—*Classification of the soil series*

Series	Family	Subgroup	Order
Albion	Coarse-loamy, mixed, thermic	Udic Argiustolls	Mollisols.
Aline	Sandy, mixed, thermic	Psammentic Paleustalfs	Alfisols.
Attica	Coarse-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Brewer	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Carwile	Fine, mixed, thermic	Typic Argiaquolls	Mollisols.
Crisfield	Coarse-loamy, mixed, thermic	Udic Haplustolls	Mollisols.
Dale	Fine-silty, mixed, thermic	Pachic Haplustolls	Mollisols.
Dillwyn	Mixed, thermic	Aquic Ustipsamments	Entisols.
Dougherty	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Drummond	Fine, mixed, thermic	Mollic Natrustalfs	Alfisols.
Goltry	Sandy, mixed, thermic	Psammentic Paleustalfs	Alfisols.
Gracemont	Coarse-loamy, mixed (calcareous), thermic	Aquic Udifluvents	Entisols.
Grant	Fine-silty, mixed, thermic	Udic Argiustolls	Mollisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
McLain	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Miller	Fine, mixed, thermic	Vertic Haplustolls	Mollisols.
Nash	Coarse-silty, mixed, thermic	Udic Haplustolls	Mollisols.
Pond Creek	Fine-silty, mixed, thermic	Pachic Argiustolls	Mollisols.
Port	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols.
Pratt	Sandy, mixed, thermic	Psammentic Haplustalfs	Alfisols.
Quinlan	Loamy, mixed, thermic, shallow	Typic Ustochrepts	Inceptisols.
Reinach	Coarse-silty, mixed, thermic	Pachic Haplustolls	Mollisols.
Renfrow	Fine, mixed, thermic	Udertic Paleustolls	Mollisols.
Ruella	Fine-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Salorthids [1]			Aridisols.
Shellabarger	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols.
Tabler	Fine, montmorillonitic, thermic	Vertic Argiustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.
Woodward	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Yahola	Coarse-loamy, mixed (calcareous), thermic	Typic Ustifluvents	Entisols.

[1] Not classified as to Family and Subgroup.

SUBORDER.—Each order is divided into suborders, mainly on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The climatic range is narrower than that of the orders.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major horizons and similarity of the significant features of corresponding horizons. The horizons considered are those in which clay, iron, or humus have accumulated and those that have a pan that interferes with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of one great group and one or more properties of another great group, suborder, or order. Subgroups may also be established in those instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup, mainly on the basis of properties that affect the growth of plants or the behavior of soils in engineering use. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils having major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. A more complete discussion of the soil series is given in the section "How This Survey Was Made." A description of each series represented in this county and a detailed description of a representative profile for each series are given in the section "Descriptions of the Soils."

General Nature of the County

This section provides information that may be useful to persons not familiar with Alfalfa County. In it are briefly discussed subjects of general interest, including relief, drainage, and climate.

When buffalo were still plentiful, the Cherokee Indians used an area two counties wide to travel from the eastern part of Oklahoma to their hunting grounds farther west. The area through which they traveled was called the Cherokee Outlet. It included what is now Alfalfa County. After the buffalo disappeared, the Cherokee Outlet was no longer used for its original purpose, and it was opened for settlement. On September 16, 1893, Alfalfa County was settled by establishing a run along its northern boundary. Those who successfully participated in the run were allowed to homestead 160 acres.

Soils suitable for farming are the primary natural resource of Alfalfa County, and they attracted the first settlers to the area. After settlement was made, oil and

gas were discovered. They are produced in two major areas—one near Cherokee and the other near Helena and Aline. The oil and gas industry and other small industries are important to the economy of the county, but farming is the leading enterprise. Small grains, alfalfa, and beef cattle are the main sources of income. The small grains not only are harvested for grain, but they also protect the soils from blowing and water erosion and provide grazing for livestock in winter. Such soils as Brewer silt loam are well suited to alfalfa. About one-third of the total acreage in the county is in native range and is used to graze livestock.

The county is served by three railroads and by an airport facility located at Cherokee. It is also served by one Federal highway, by five State highways, and by numerous county roads, some of which have been surfaced and are suitable for all-weather travel.

Relief and Drainage

In more than 70 percent of Alfalfa County, the soils are nearly level or very gently sloping. The soils in some areas, however, are steep and shallow.

Most parts of this county are drained by the Salt Fork of the Arkansas River and its tributaries, which include Wagon Creek, Clay Creek, Cottonwood Creek, Driftwood Creek, the Medicine River, and Sandy Creek. Some areas in the southern part of the county drain southward to the Cimarron River.

Climate [7]

The climate of Alfalfa County is mainly under continental controls, which determine climate of the Great Plains region. At times, however, warm, moist air from the Gulf of Mexico exerts some influence. The continental effects on climate result in pronounced daily and seasonal changes in temperature and in considerable variation in the amount of seasonal and annual precipitation received. Summers are long and are usually hot; winters are comparatively mild and are short.

Temperatures and precipitation recorded for the town of Cherokee are fairly representative for all of Alfalfa County. Data taken from records kept at Cherokee show that the average daily maximum temperature ranges from 48° F in January to 96° F in July and August. They also show that the average daily minimum temperature ranges from 24° F in January to 70° F in July. Table 8 gives data for temperatures and precipitation that are representative for this county. Table 9 shows the probabilities of the last freezing temperatures in spring and the first in fall.

This county has a growing season of about 200 days. Freezing temperatures occur on an average of 100 days each year. On an average of 9 days per year, the maximum temperature is 32° F or less, and on an average of 1 day per year, the minimum temperature is zero or less. On an average of 93 days per year, the temperature is 90° F or higher, and on an average of 27 days per year, the temperature is 100° or higher. In July 1954 a temperature of 100 degrees or higher was reached on 27 days. On August 12, 1936, a record high temperature of 117° F was reached at Cherokee. In contrast, on January 18, 1930, a record low temperature of 14 degrees below zero was reached.

The average annual precipitation is 27 inches. Of this amount, 36 percent falls in summer, 21 percent in spring, 21 percent in fall, and 12 percent in winter. A measurable amount of precipitation falls on about 80 days each year. Much of the precipitation falls during thunderstorms, which occur on an average of 40 days each year. In 1957, the wettest year of record in Cherokee, nearly

[7] By STANLEY G. HOLBROOK, climatologist for Oklahoma, National Weather Service, U.S. Department of Commerce.

TABLE 8.—*Temperature and precipitation at Cherokee, Okla.—1939–68*

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average monthly total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Days with 1 inch or more of snow cover	Average depth of snow on days with snow cover
	°F	°F	°F	°F	In	In	In		In
January	48	24	72	6	0.9	0.2	1.6	4	2
February	54	28	75	11	1.1	.2	2.6	1	2
March	63	35	85	15	1.5	.3	2.8	1	3
April	73	47	91	29	2.9	.7	6.8	0	0
May	81	56	96	39	3.9	.8	7.9	0	0
June	91	66	102	52	4.1	.8	9.0	0	0
July	96	70	106	59	2.6	.3	5.8	0	0
August	96	69	106	56	3.0	.9	6.0	0	0
September	87	60	100	43	2.4	.2	5.7	0	0
October	77	49	92	31	2.0	.4	4.6	0	0
November	61	35	78	18	1.4	([1])	3.6	([2])	1
December	51	26	72	8	1.2	.1	2.8	3	2
Year	73	47	[3] 108	[4] 1	27.0	15.2	35.2	9	2

[1] Trace.
[2] Less than one-half day.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[Based on records taken at Cherokee, Okla.—1921–68]

Probability	Dates for given probability and temperature				
	16° F	20° F	24° F	28° F	32° F
Spring:					
1 year in 10 later than	March 27	April 1	April 7	April 15	April 27
2 years in 10 later than	March 19	March 26	April 2	April 10	April 22
5 years in 10 later than	March 6	March 12	March 22	April 1	April 12
Fall:					
1 year in 10 earlier than	November 13	November 4	October 31	October 22	October 15
2 years in 10 earlier than	November 21	November 12	November 6	October 27	October 20
5 years in 10 earlier than	December 8	November 27	November 17	November 6	October 29

44 inches of precipitation was measured. In 1956, the driest year of record in Cherokee, slightly less than 9 inches of precipitation was measured. The greatest amount of monthly rainfall recorded at Cherokee is 11 inches, which occurred in June 1951. The greatest amount of daily rainfall, 4½ inches, occurred on April 22, 1944.

The average annual snowfall is about 16 inches. Of this amount about 5 inches falls in February. The largest amount of snowfall received in any one season, 25 inches, fell during the winter of 1918–19. The largest amount of snowfall received in any month, 16 inches, was received in January 1962. Snow greatly benefits winter wheat, for it provides deep soil moisture that is necessary for the vigorous growth and development of the crop in spring.

Except during January and February, when winds are mainly from the north, prevailing winds are from the south. Average windspeed is 13 miles per hour. Spring is the windiest season. During that part of the year, gusty southwesterly winds of 30 to 45 miles per hour are not uncommon.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Bench terrace. A shelflike embankment of earth that has a level or nearly level top and a steep or nearly vertical downhill face, constructed along the contour of sloping land or across the slope to control runoff and erosion. The downhill face of the bench may be made of rocks or masonry, or it may be planted to vegetation.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Color, soil. See Munsell notation.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Decreaser. Any of the climax range plants most heavily grazed. Because they are the most palatable, they are first to be destroyed by overgrazing.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Increasers. Species in the climax vegetation that increase in relative amount as the more desirable plants are reduced by close grazing; increasers commonly are shorter than decreasers, and some are less palatable to livestock.

Invaders. On range, plants that come in and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface. (Most weeds are "invaders").

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tillage of a soil below normal depth ordinarily to shatter a hardpan or claypan.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Trace elements. The chemical elements found in soils in extremely small amounts, yet which are essential to plant growth. Some of the trace elements are zinc, cobalt, manganese, copper, and iron.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
ALFALFA COUNTY, OKLAHOMA

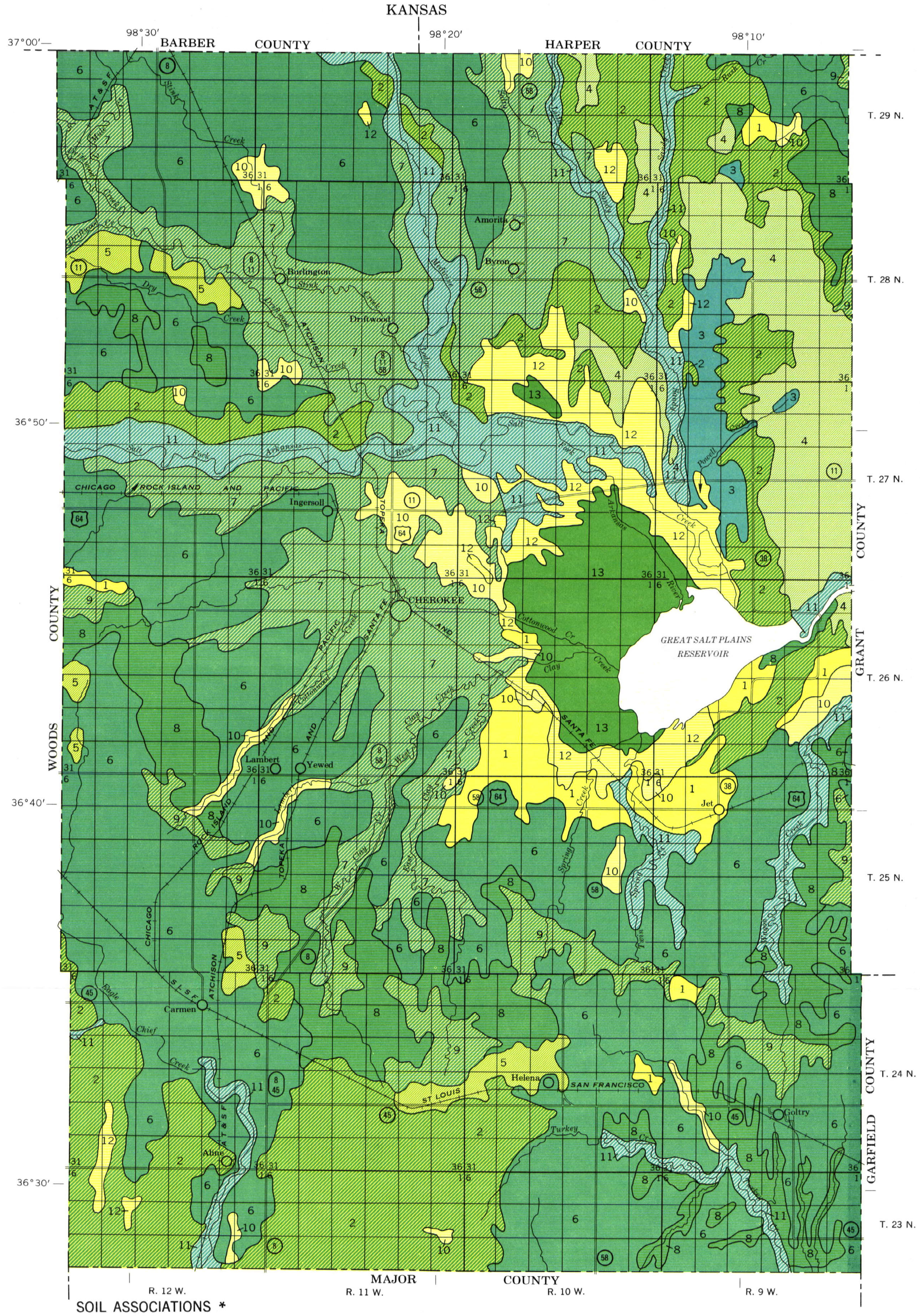
Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

N



SOIL ASSOCIATIONS *

DEEP, LOAMY OR SANDY, RAPIDLY THROUGH MODERATELY PERMEABLE SOILS ON UPLANDS

1 Albion association: Nearly level through moderately steep, well drained or somewhat excessively drained loamy soils

2 Attica-Pratt-Shellabarger association: Nearly level through sloping, well drained loamy and sandy soils

3 Goltry-Dillwyn association: Nearly level or very gently sloping, moderately well drained or somewhat poorly drained sandy soils

4 Tivoli-Aline association: Nearly level through steep, excessively drained or somewhat excessively drained sandy soils

DEEP THROUGH SHALLOW, LOAMY, MODERATELY RAPIDLY THROUGH VERY SLOWLY PERMEABLE SOILS ON UPLANDS OR TERRACES

5 Renfrow-Tabler association: Nearly level or very gently sloping, deep, well drained or moderately well drained soils on uplands

6 Pond Creek-Grant association: Nearly level through strongly sloping, deep, well drained soils on uplands

7 Dale-Reinach-Brewer association: Nearly level through sloping, deep, well drained or moderately well drained soils on terraces

8 Quinlan-Woodward-Grant association: Very gently sloping through strongly sloping, shallow, moderately deep or deep, well drained soils on uplands

9 Albion-Quinlan-Woodward association: Sloping through steep, shallow, moderately deep or deep, well drained or somewhat excessively drained soils on uplands

DEEP, LOAMY OR SANDY, RAPIDLY THROUGH VERY SLOWLY PERMEABLE SOILS ON FLOOD PLAINS OR TERRACES

10 Brewer-Dale association: Nearly level, well drained or moderately well drained loamy soils on terraces

11 Yahola-Port-Lincoln association: Nearly level or very gently sloping, well drained or somewhat excessively drained loamy or sandy soils on flood plains

12 Gracemont-Drummond association: Nearly level or very gently sloping, somewhat poorly drained loamy soils on flood plains or terraces

13 Salorthids association: Nearly level, somewhat poorly drained loamy or sandy soils on flood plains

* Texture is that of the surface layer of the major soils.

Compiled 1972

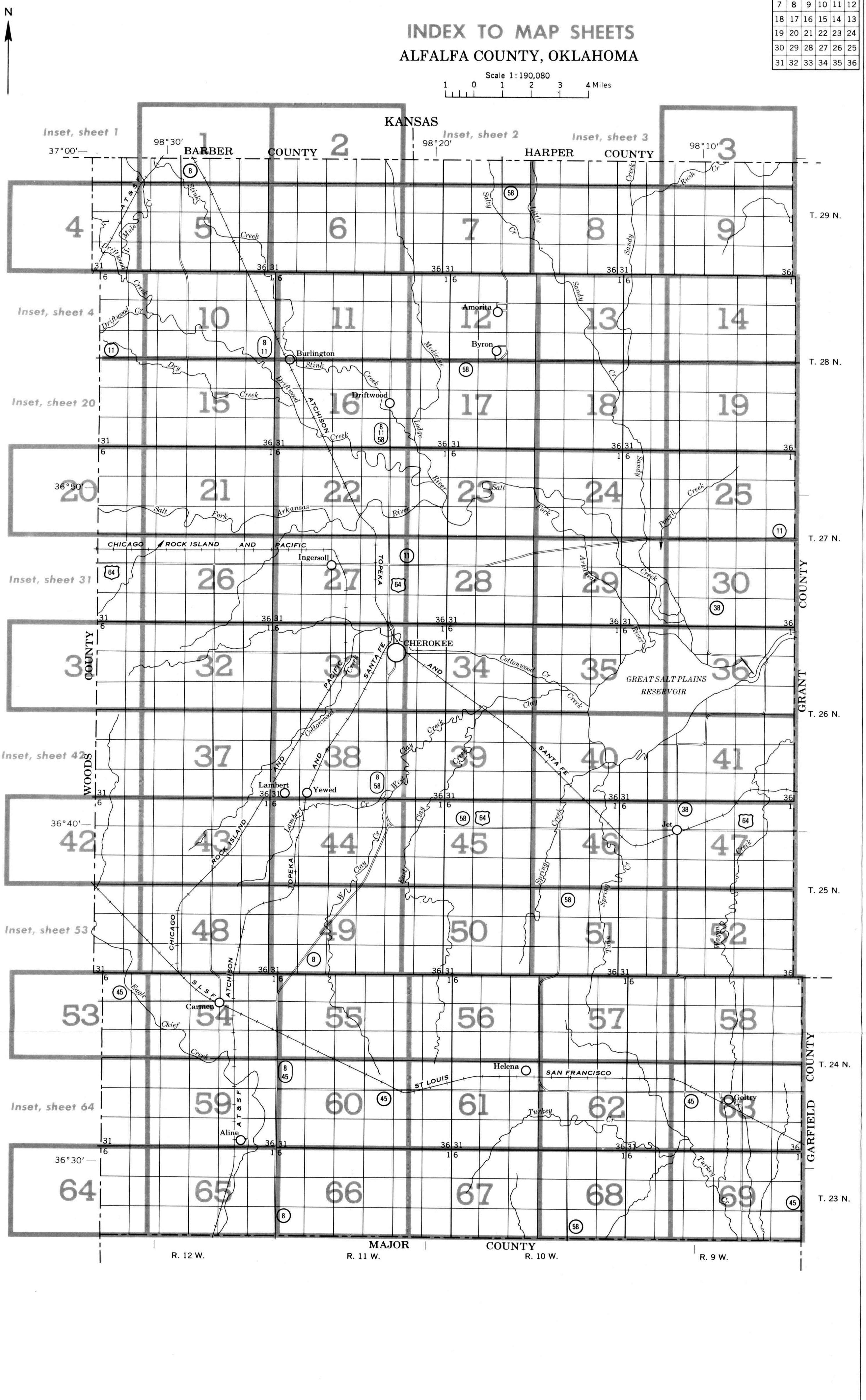
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS
ALFALFA COUNTY, OKLAHOMA

Scale 1:190,080

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for soils that have a considerable range of slope. A final number, 2, in a symbol indicates that the soil is eroded.

SYMBOL	NAME
AbA	Albion sandy loam, 0 to 1 percent slopes
AbB	Albion sandy loam, 1 to 3 percent slopes
AbC	Albion sandy loam, 3 to 5 percent slopes
AbE	Albion sandy loam, 5 to 15 percent slopes
AgC	Albion-Grant complex, 3 to 5 percent slopes
AgC2	Albion-Grant complex, 3 to 5 percent slopes, eroded
AgD2	Albion-Grant complex, 5 to 8 percent slopes, eroded
AlB	Aline fine sand, 0 to 3 percent slopes
AnE	Aline-Tivoli complex, 5 to 12 percent slopes
AsB	Attica loamy fine sand, 0 to 3 percent slopes
AtB	Attica fine sandy loam, 0 to 3 percent slopes
AtC	Attica fine sandy loam, 3 to 5 percent slopes
Br	Brewer silt loam
Bu	Brewer-Drummond complex
CaB	Carwile-Attica complex, 0 to 3 percent slopes
Cr	Crisfield fine sandy loam
DaA	Dale silt loam, 0 to 1 percent slopes
De	Dale silt loam, saline
DlD	Dale soils, 3 to 8 percent slopes
Dm	Dillwyn loamy fine sand
DoB	Dougherty fine sand, 0 to 3 percent slopes
DrB	Drummond soils, 0 to 3 percent slopes
DtB	Drummond-Pratt complex, 0 to 3 percent slopes
GoB	Goltry fine sand, 0 to 3 percent slopes
Gp	Gracemont soils
GrB	Grant silt loam, 1 to 3 percent slopes
GrC	Grant silt loam, 3 to 5 percent slopes
GrC2	Grant silt loam, 3 to 5 percent slopes, eroded
GtD2	Grant-Nash complex, 3 to 8 percent slopes, eroded
GuE	Grant-Port complex, 0 to 12 percent slopes
Ls	Lincoln soils
Mc	McLain silt loam
Mr	Miller clay
PcA	Pond Creek silt loam, 0 to 1 percent slopes
PcB	Pond Creek silt loam, 1 to 3 percent slopes
Pr	Port silt loam
PtB	Pratt loamy fine sand, 0 to 3 percent slopes
PtC	Pratt loamy fine sand, 3 to 8 percent slopes
QwC	Quinlan-Woodward complex, 3 to 5 percent slopes
QwE	Quinlan-Woodward complex, 5 to 30 percent slopes
Ra	Reinach very fine sandy loam
RcA	Renfrow silt loam, 0 to 2 percent slopes
RuA	Ruella loam, 0 to 2 percent slopes
Sa	Salorthids
ShB	Shellabarger fine sandy loam, 1 to 3 percent slopes
TaA	Tabler silty clay loam, 0 to 1 percent slopes
Tr	Tivoli fine sand
WuB	Woodward-Quinlan complex, 1 to 3 percent slopes
Ya	Yahola soils
Yp	Yahola and Port soils, frequently flooded

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Saline spot

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which it belongs. A technical description of a profile that is representative of the series is discussed under the series. Suitability of the soils for use as cropland is discussed in the soil descriptions. The capability classification system is discussed on pages 34 to 36. For information about the suitability of soils for tame pasture, see the section beginning on page 36. Range management is described on pages 40 to 45. For information on the uses of soils for tree planting and for wildlife habitat, see those sections beginning on pages 45 and 47, respectively. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 37.
Wildlife, table 3, p. 48.

Engineering uses of the soils, tables 4, 5, and 6, pp. 54 to 69.

Map symbol	Mapping unit	Page	Capability unit	Range site	Tame pasture suitability group	Tree suitability group
			Symbol	Name	Symbol	Name
AbA	Albion sandy loam, 0 to 1 percent slopes	6	IIIs-2	Sandy Prairie	11A	Loamy Upland
AbB	Albion sandy loam, 1 to 3 percent slopes	7	IIIe-5	Sandy Prairie	11A	Loamy Upland
AbC	Albion sandy loam, 3 to 5 percent slopes	7	IVe-2	Sandy Prairie	11A	Loamy Upland
AbE	Albion sandy loam, 5 to 15 percent slopes	8	VIe-1	Sandy Prairie	11A	Loamy Upland
AgC	Albion-Grant complex, 3 to 5 percent slopes	8	IVe-2	------------------	---	Loamy Upland
	Albion part	--	------	Sandy Prairie	11A	----------------
	Grant part	--	------	Loamy Prairie	8A	----------------
AgC2	Albion-Grant complex, 3 to 5 percent slopes, eroded	8	IVe-4	------------------	---	Loamy Upland
	Albion part	--	------	Sandy Prairie	11A	----------------
	Grant part	--	------	Loamy Prairie	8A	----------------
AgD2	Albion-Grant complex, 5 to 8 percent slopes, eroded	8	IVe-5	------------------	---	Loamy Upland
	Albion part	--	------	Sandy Prairie	11A	----------------
	Grant part	--	------	Loamy Prairie	8A	----------------
AlB	Aline fine sand, 0 to 3 percent slopes	9	IVs-1	Deep Sand	9A	Sandy
AnE	Aline-Tivoli complex, 5 to 12 percent slopes	9	VIe-2	Deep Sand	9A	Very Sandy
AsB	Attica loamy fine sand, 0 to 3 percent slopes	10	IIIe-7	Deep Sand	9A	Sandy
AtB	Attica fine sandy loam, 0 to 3 percent slopes	10	IIe-3	Sandy Prairie	8A	Loamy Upland
AtC	Attica fine sandy loam, 3 to 5 percent slopes	10	IIIe-5	Sandy Prairie	8A	Loamy Upland
Br	Brewer silt loam	11	I-1	Loamy Bottomland	2A	Loamy Bottomland
Bu	Brewer-Drummond complex	12	IIIs-1	------------------	2C	Saline
	Brewer part	--	------	Loamy Bottomland	---	----------------
	Drummond part	--	------	Saline Subirrigated	---	----------------
CaB	Carwile-Attica complex, 0 to 3 percent slopes	13	IIw-1	Sandy Prairie	8A	Loamy Upland
Cr	Crisfield fine sandy loam	14	I-3	Loamy Bottomland	2A	Loamy Bottomland
DaA	Dale silt loam, 0 to 1 percent slopes	15	I-1	Loamy Bottomland	2A	Loamy Bottomland
De	Dale silt loam, saline	15	IIIs-1	Loamy Bottomland	2A	Saline
DlD	Dale soils, 3 to 8 percent slopes	15	IIIe-6	Loamy Bottomland	2A	Loamy Bottomland
Dm	Dillwyn loamy fine sand	16	IVw-1	Subirrigated	9C	Moist Sandy
DoB	Dougherty fine sand, 0 to 3 percent slopes	17	IVs-1	Deep Sand	9A	Sandy
DrB	Drummond soils, 0 to 3 percent slopes	17	Vs-1	Saline Subirrigated	2C	Saline
DtB	Drummond-Pratt complex, 0 to 3 percent slopes	18	Vs-2	------------------	---	Saline
	Drummond part	--	------	Saline Subirrigated	2C	----------------
	Pratt part	--	------	Deep Sand	9A	----------------
GoB	Goltry fine sand, 0 to 3 percent slopes	19	IVs-1	Subirrigated	9C	Moist Sandy
Gp	Gracemont soils	19	Vw-1	Saline Subirrigated	2C	Saline
GrB	Grant silt loam, 1 to 3 percent slopes	20	IIe-1	Loamy Prairie	8A	Loamy Upland
GrC	Grant silt loam, 3 to 5 percent slopes	20	IIIe-2	Loamy Prairie	8A	Loamy Upland
GrC2	Grant silt loam, 3 to 5 percent slopes, eroded	21	IIIe-3	Loamy Prairie	8A	Loamy Upland
GtD2	Grant-Nash complex, 3 to 8 percent slopes, eroded	21	IVe-1	Loamy Prairie	---	Loamy Upland
	Grant part	--	------	------------------	8A	----------------
	Nash part	--	------	------------------	11A	----------------
GuE	Grant-Port complex, 0 to 12 percent slopes	21	VIe-3	------------------	---	Loamy Upland
	Grant part	--	------	Loamy Prairie	8A	----------------
	Port part	--	------	Loamy Bottomland	2A	----------------
Ls	Lincoln soils	22	Vw-2	Sandy Bottomland	3A	Sandy
Mc	McLain silt loam	22	I-1	Loamy Bottomland	2A	Loamy Bottomland
Mr	Miller clay	23	IIIw-1	Heavy Bottomland	1A	Clayey
PcA	Pond Creek silt loam, 0 to 1 percent slopes	24	I-2	Loamy Prairie	8A	Loamy Upland
PcB	Pond Creek silt loam, 1 to 3 percent slopes	25	IIe-1	Loamy Prairie	8A	Loamy Upland
Pr	Port silt loam	25	IIw-2	Loamy Bottomland	2A	Loamy Bottomland
PtB	Pratt loamy fine sand, 0 to 3 percent slopes	26	IIIe-7	Deep Sand	9A	Sandy
PtC	Pratt loamy fine sand, 3 to 8 percent slopes	26	IVe-3	Deep Sand	9A	Sandy
QwC	Quinlan-Woodward complex, 3 to 5 percent slopes	26	IVe-1	------------------	---	Shallow
	Quinlan part	--	------	Shallow Prairie	14A	----------------
	Woodward part	--	------	Loamy Prairie	11A	----------------
QwE	Quinlan-Woodward complex, 5 to 30 percent slopes	27	VIe-4	------------------	---	Shallow
	Quinlan part	--	------	Shallow Prairie	14A	----------------
	Woodward part	--	------	Loamy Prairie	11A	----------------
Ra	Reinach very fine sandy loam	28	I-1	Loamy Bottomland	2A	Loamy Bottomland
RcA	Renfrow silt loam, 0 to 2 percent slopes	28	IIIe-1	Claypan Prairie	8C	Clayey
RuA	Ruella loam, 0 to 2 percent slopes	29	IIe-1	Loamy Prairie	8A	Loamy Upland
Sa	Salorthids	29	VIIIs-1	------------------	---	Undesirable
ShB	Shellabarger fine sandy loam, 1 to 3 percent slopes	30	IIe-2	Sandy Prairie	8A	Loamy Upland
TaA	Tabler silty clay loam, 0 to 1 percent slopes	31	IIs-1	Claypan Prairie	8C	Clayey
Tr	Tivoli fine sand	31	VIIe-1	Dune	---	Very Sandy
WuB	Woodward-Quinlan complex, 1 to 3 percent slopes	32	IIIe-4	------------------	---	Shallow
	Woodward part	--	------	Loamy Prairie	11A	----------------
	Quinlan part	--	------	Shallow Prairie	14A	----------------
Ya	Yahola soils	32	IIw-3	Loamy Bottomland	2A	Loamy Bottomland
Yp	Yahola and Port soils, frequently flooded	33	Vw-3	Loamy Bottomland	2A	Loamy Bottomland

ALFALFA COUNTY, OKLAHOMA NO. 1

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

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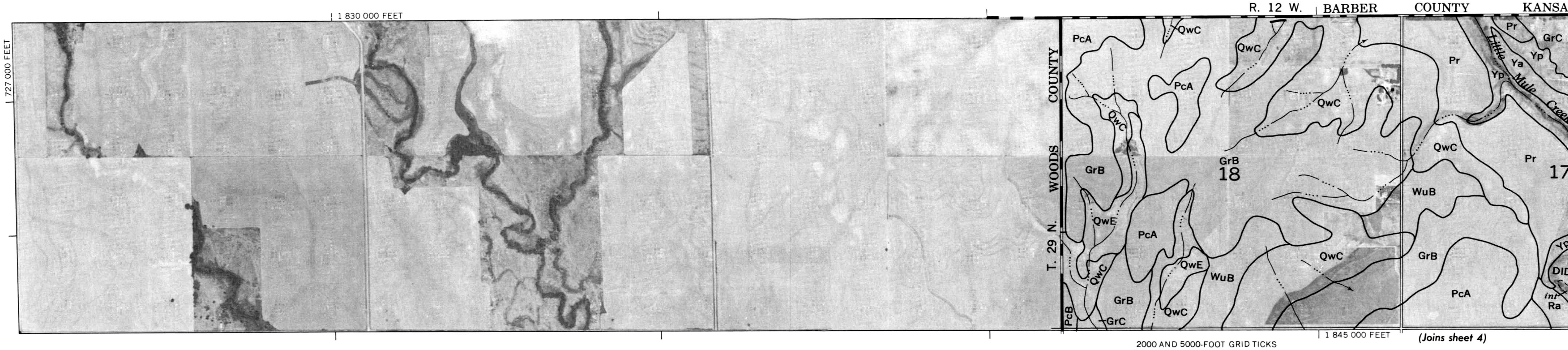

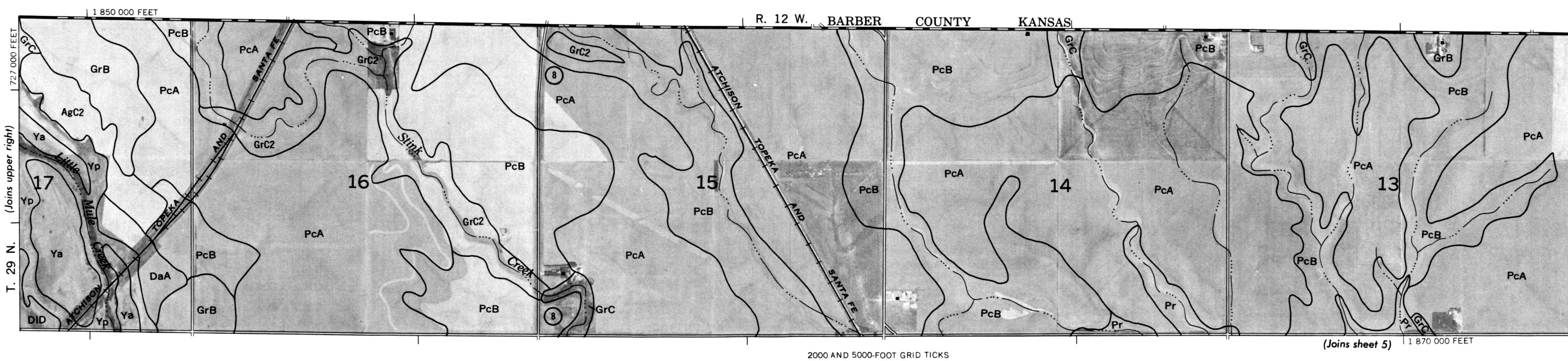

1 Mile
5000 Feet
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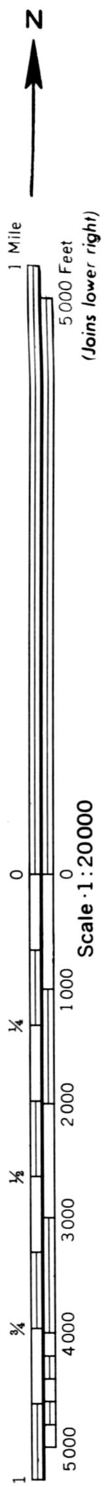
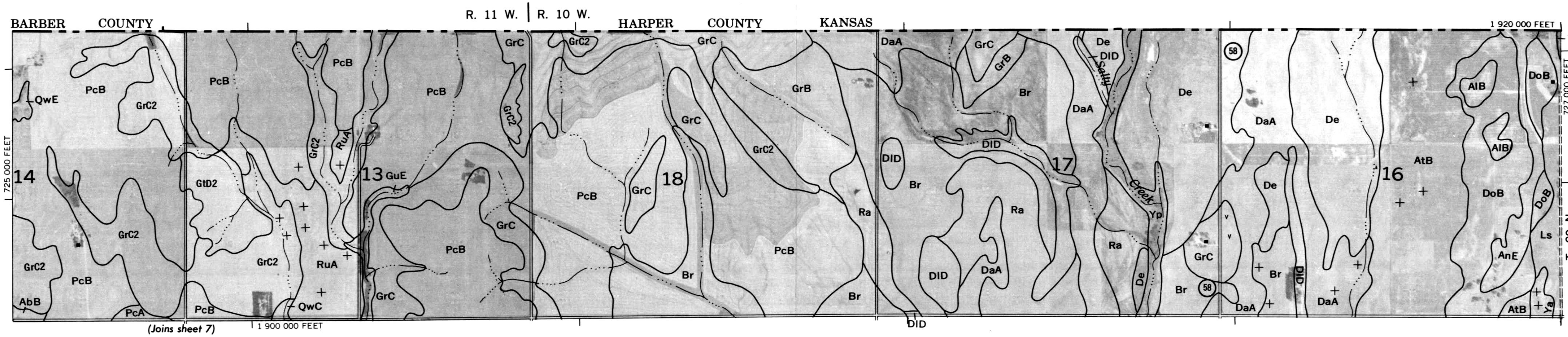
3000
4000
5000
Scale 1:20000

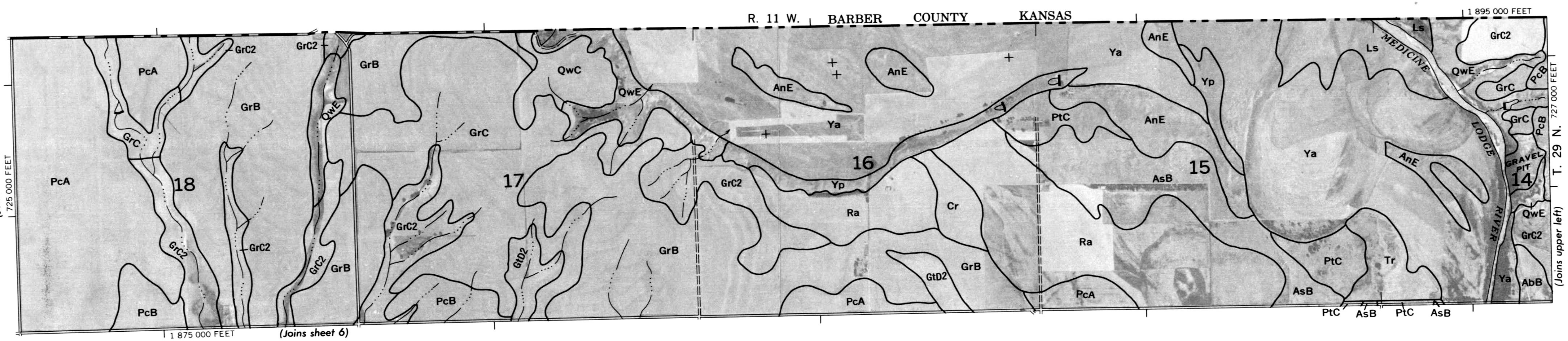
2

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 2





2000 AND 5000-FOOT GRID TICKS



2000 AND 5000-FOOT GRID TICKS

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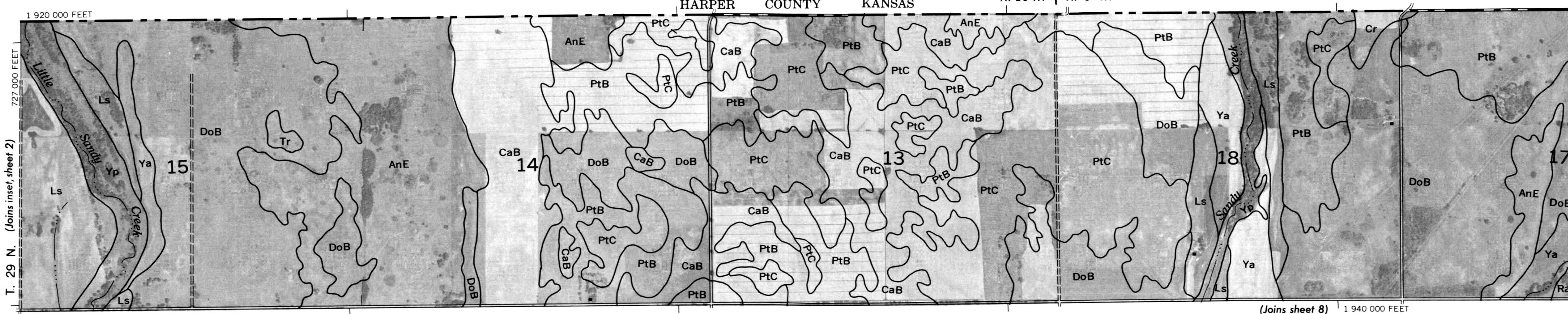
ALFALFA COUNTY, OKLAHOMA NO. 2

3

N



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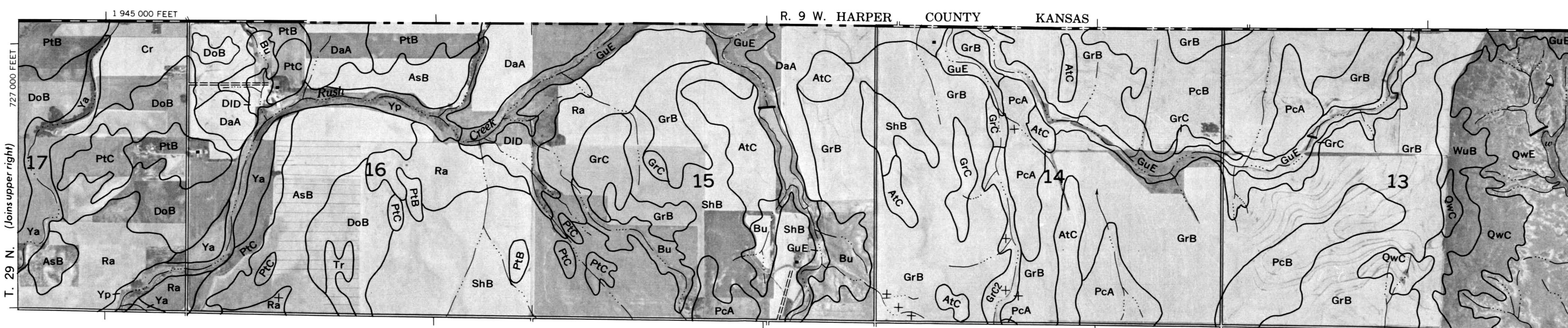

4000 AND 5000-FOOT GRID TICKS

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
Scale 1:20000

ALFALFA COUNTY, OKLAHOMA NO. 3

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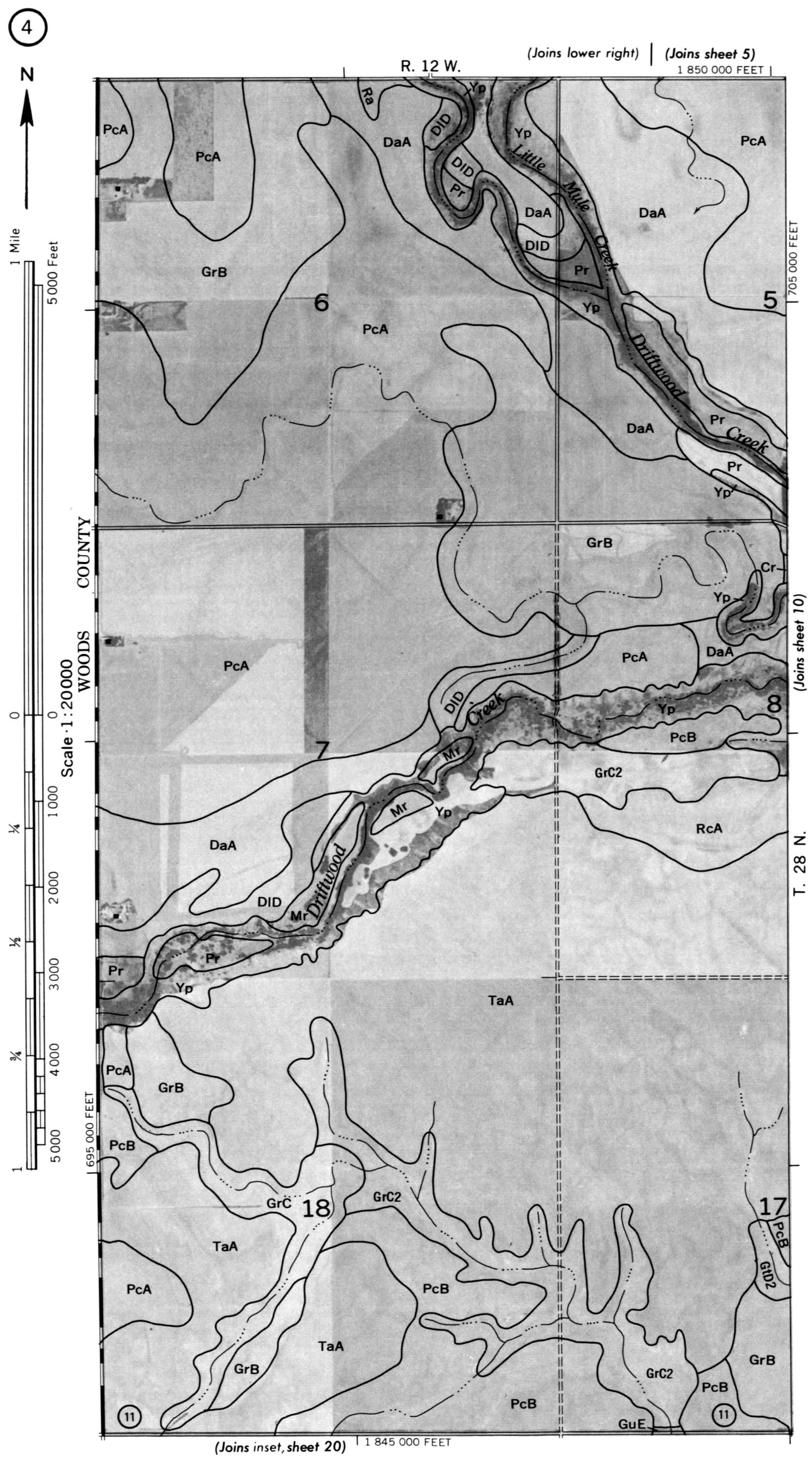

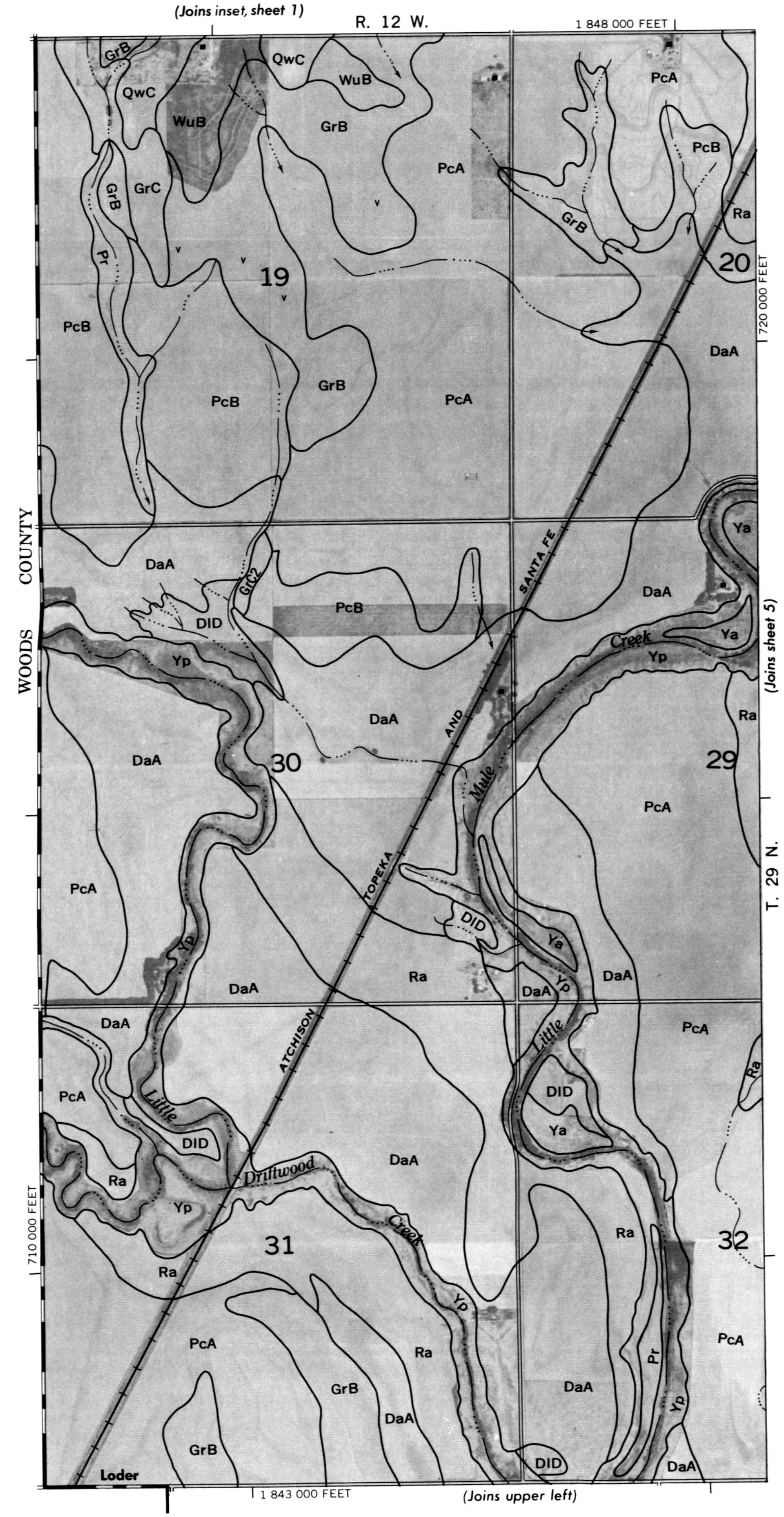

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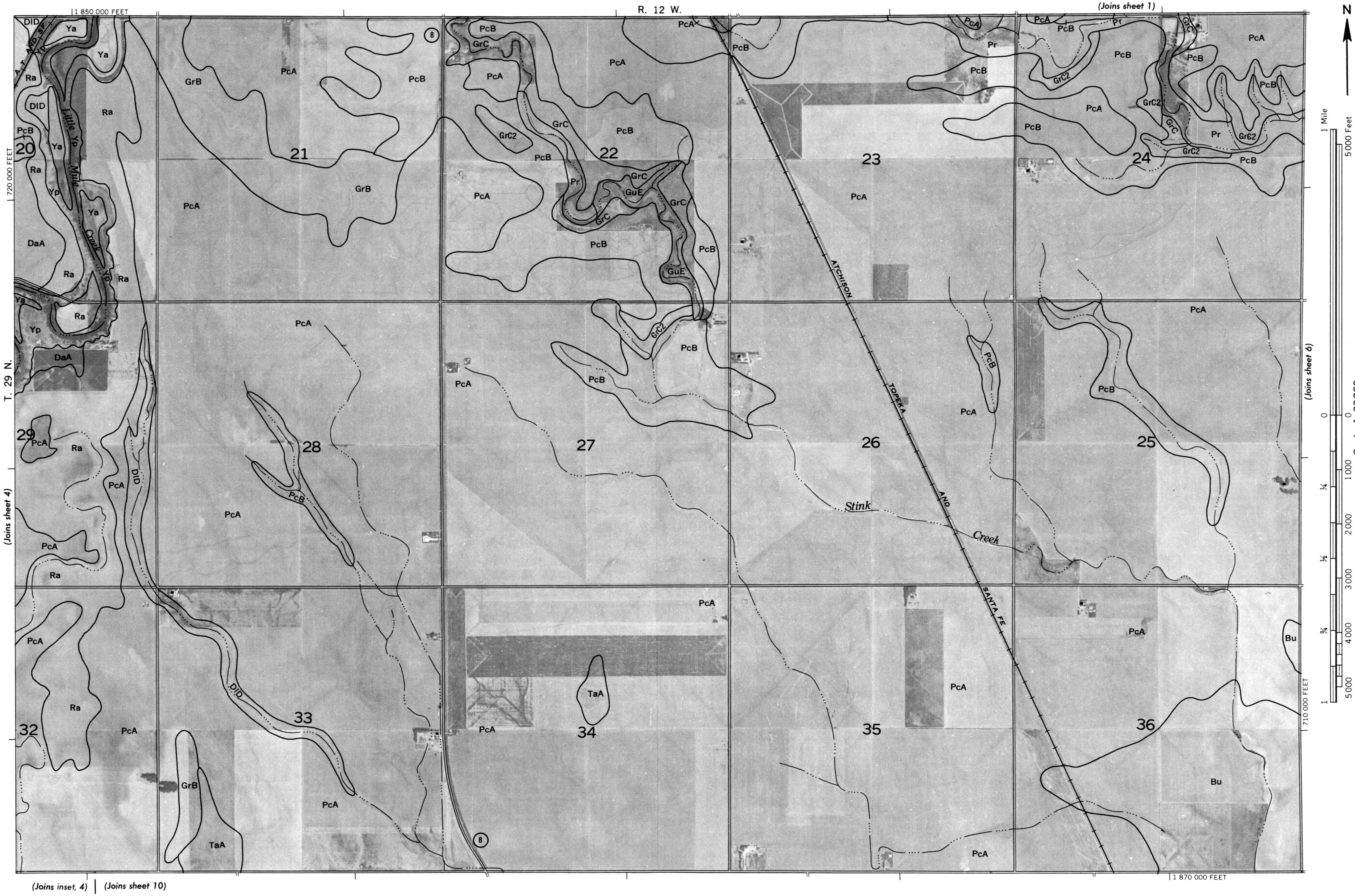
ALFALFA COUNTY, OKLAHOMA NO. 4



ALFALFA COUNTY, OKLAHOMA NO. 5

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6

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 6

Land division corners are approximately positioned on this map.
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ALFALFA COUNTY, OKLAHOMA NO. 6

7

ALFALFA COUNTY, OKLAHOMA NO. 7

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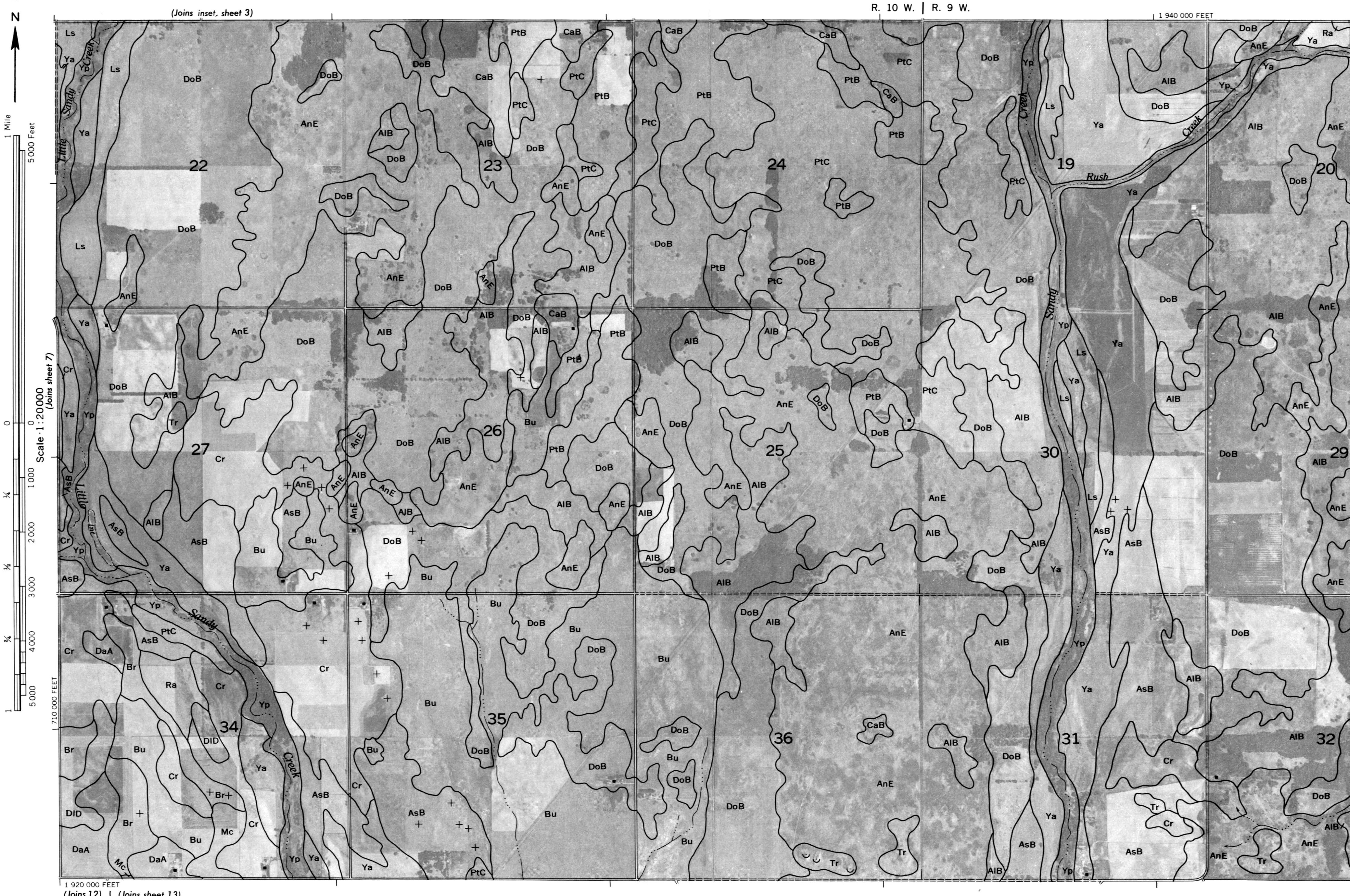
ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 8



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ALFALFA COUNTY, OKLAHOMA NO. 8

9

ALFALFA COUNTY, OKLAHOMA NO. 9

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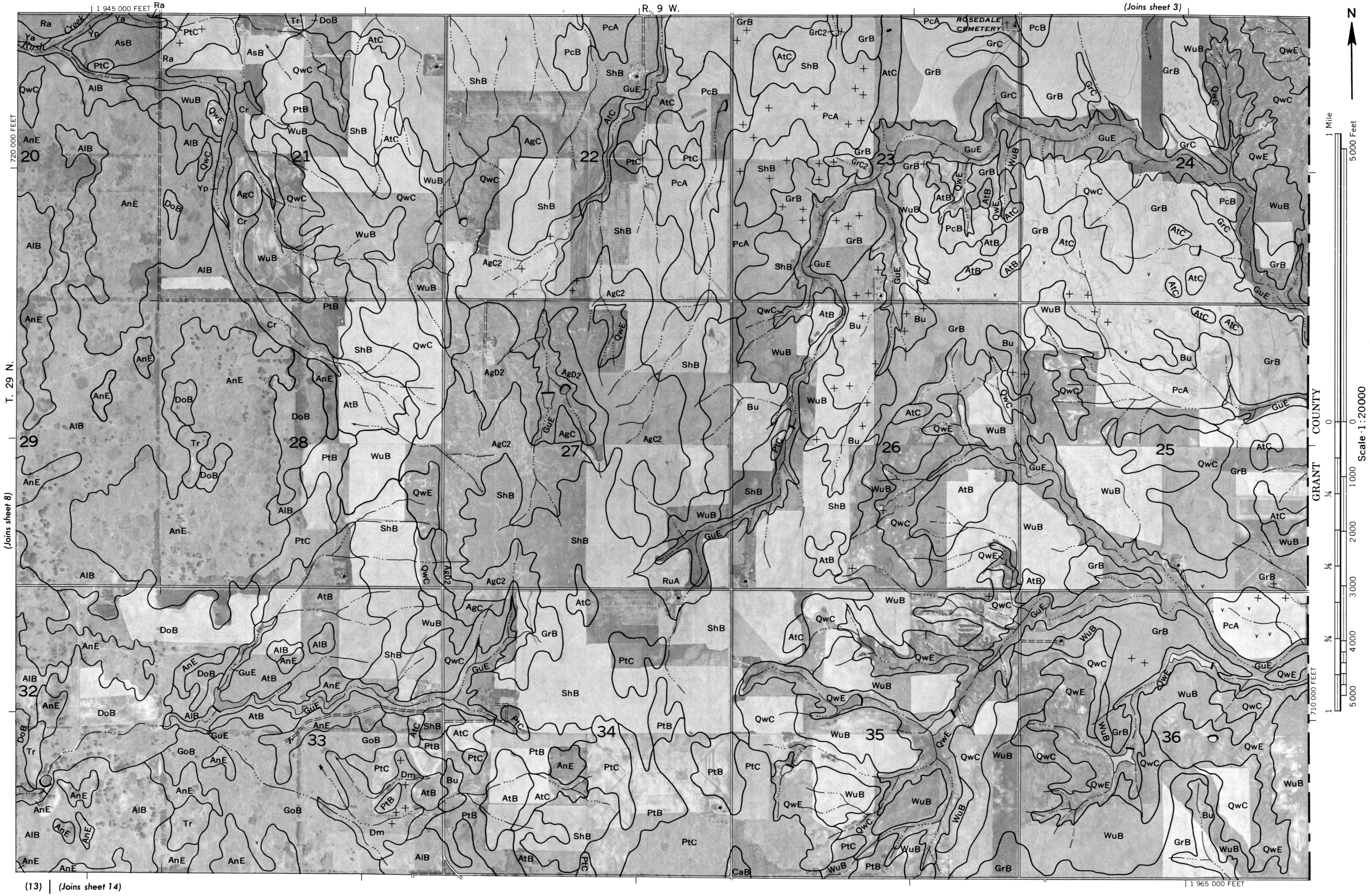
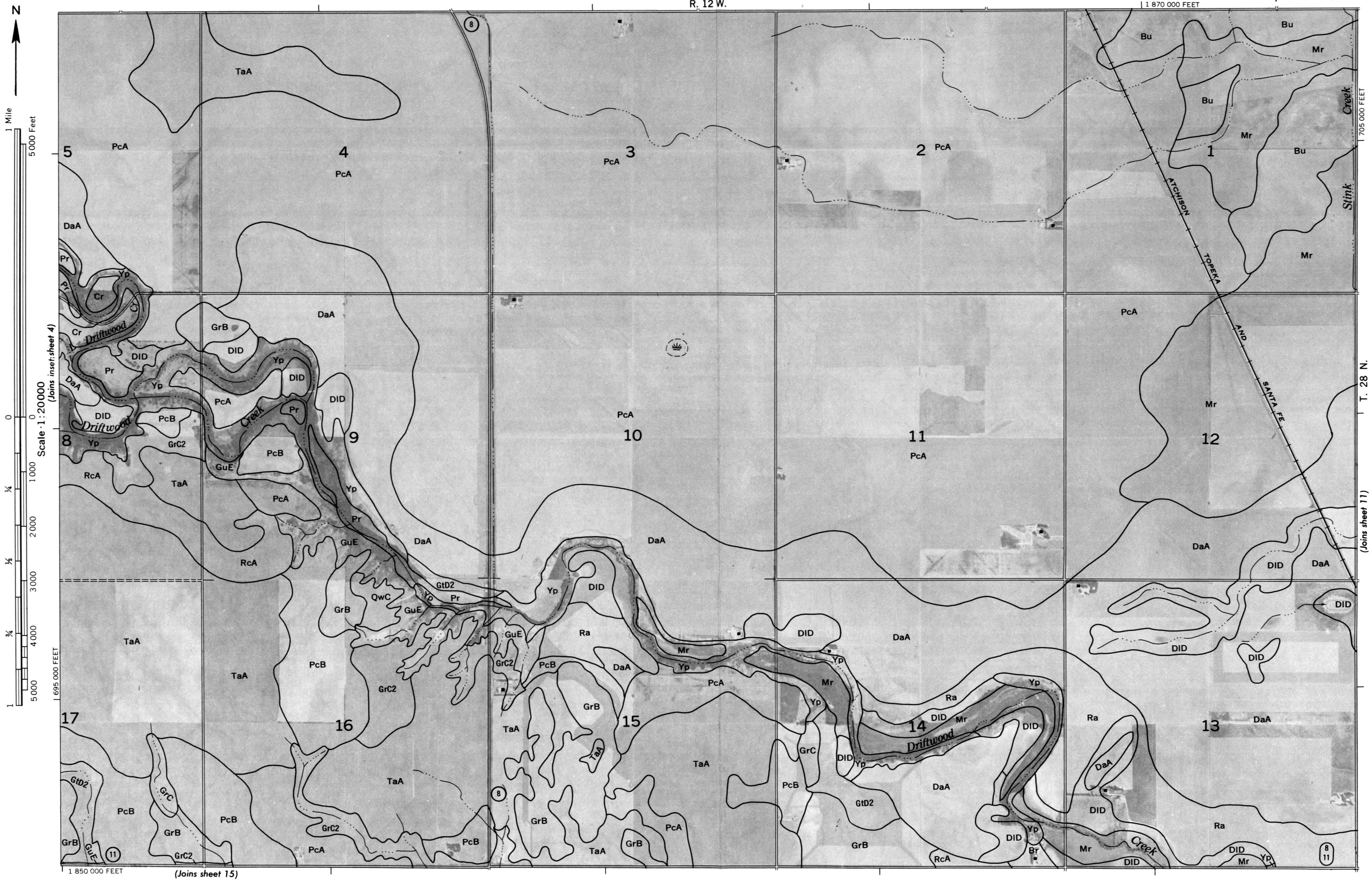


ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 10



Land division corners are approximately positioned on this map.

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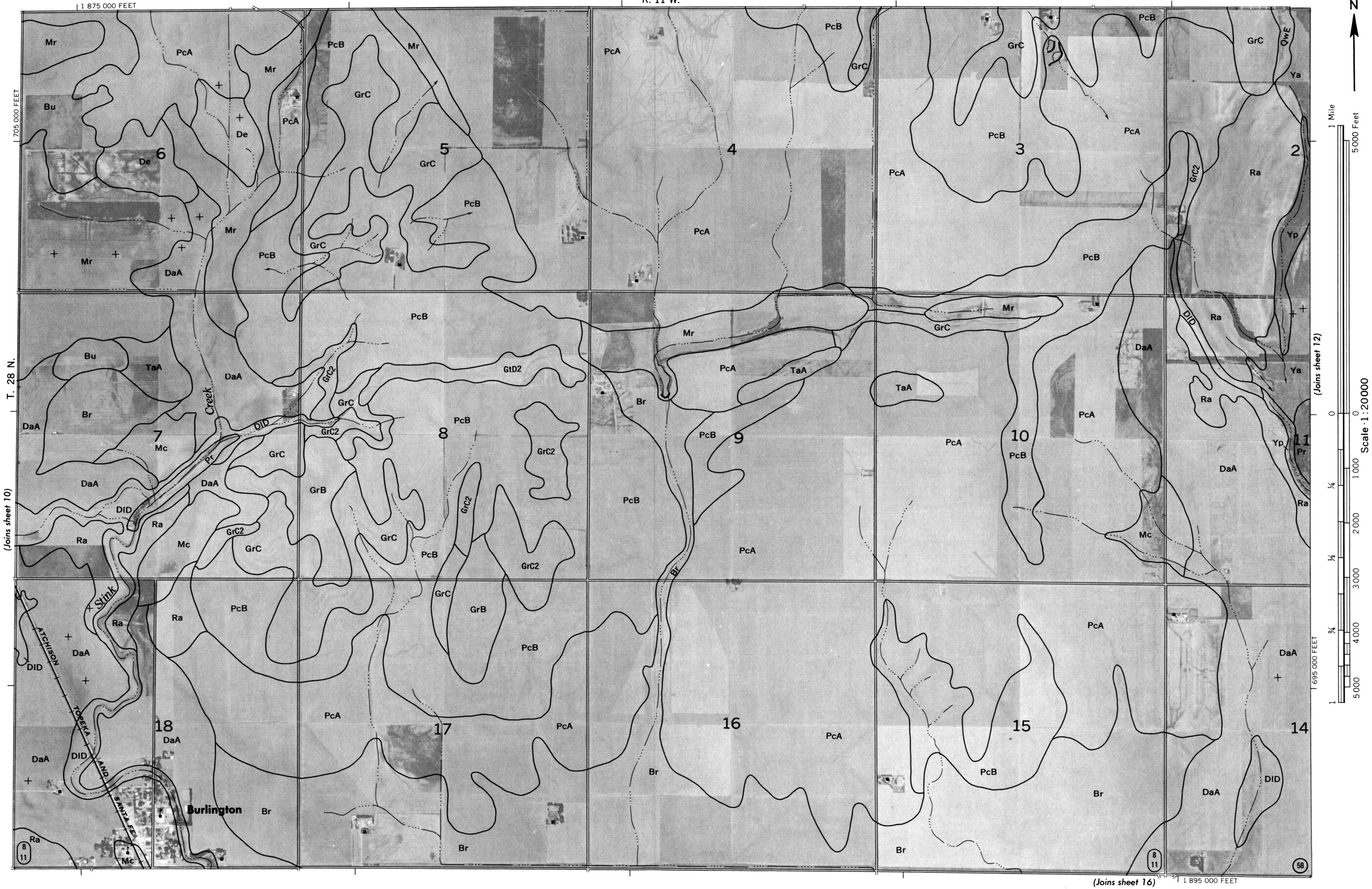
ALFALFA COUNTY, OKLAHOMA NO. 10

11



ALFALFA COUNTY, OKLAHOMA NO. 11

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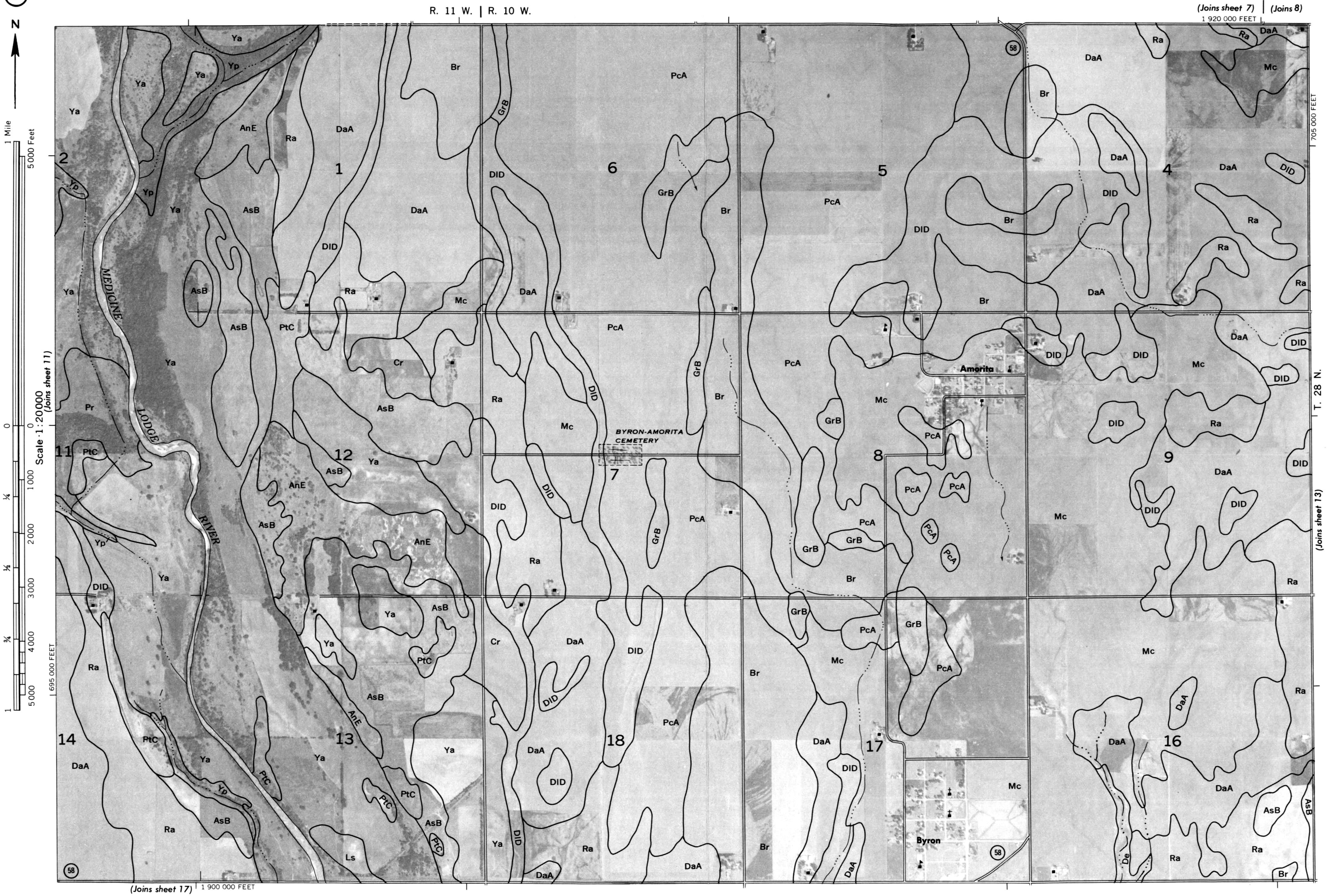
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 12



Land division corners are approximately positioned on this map.

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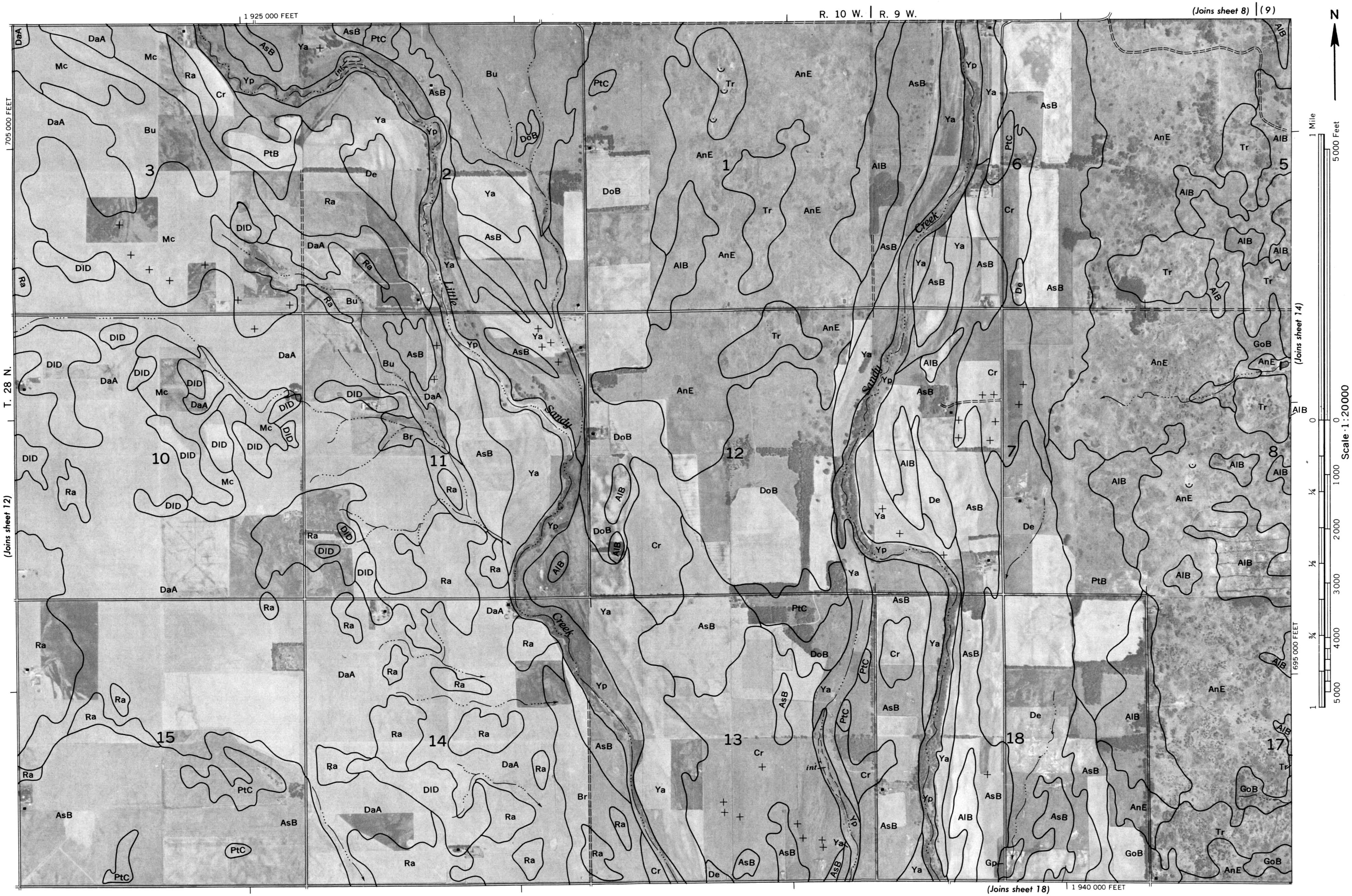

ALFALFA COUNTY, OKLAHOMA NO. 13

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 14

Land division corners are approximately positioned on this map.

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ALFALFA COUNTY, OKLAHOMA NO. 15

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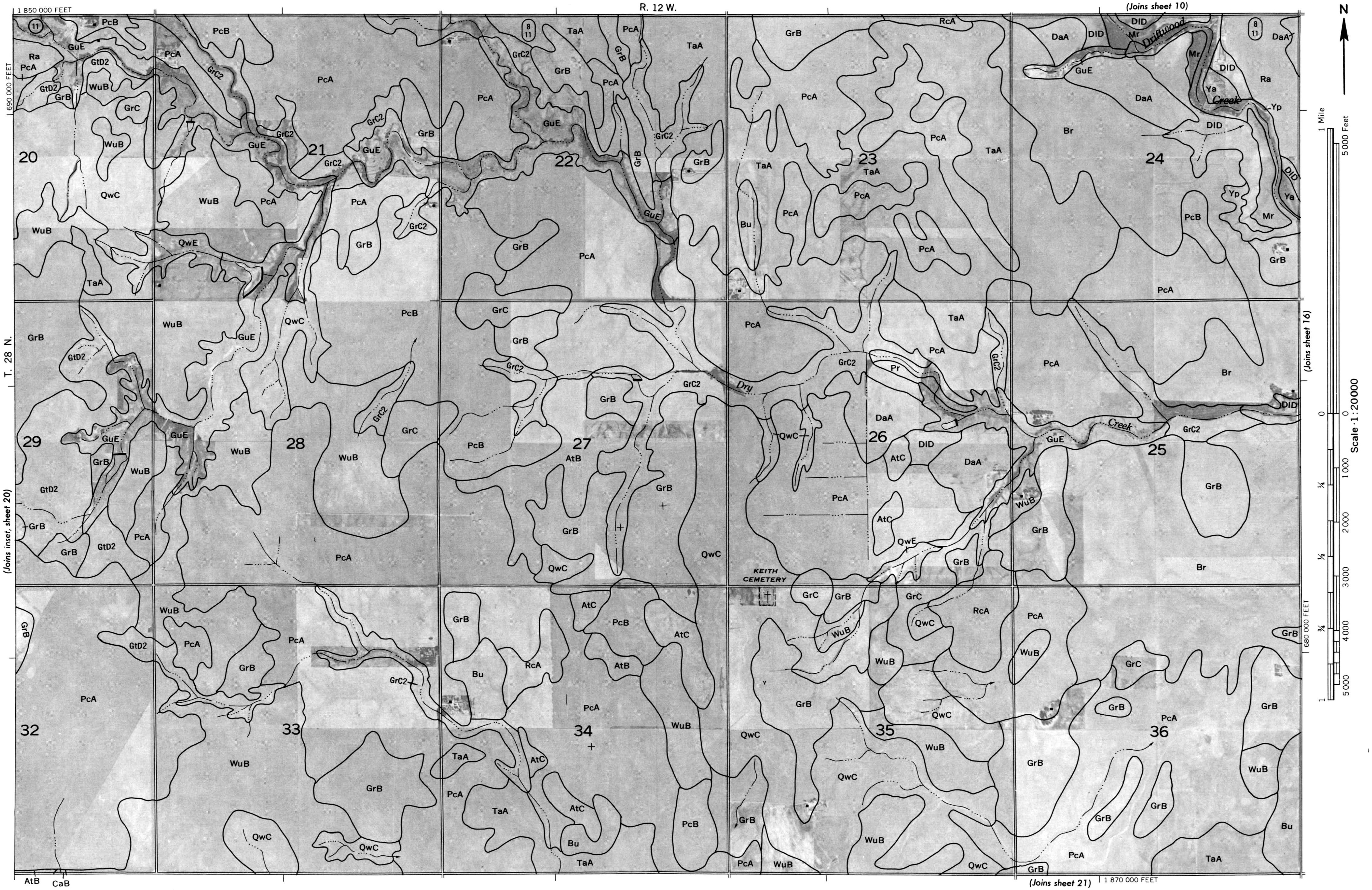
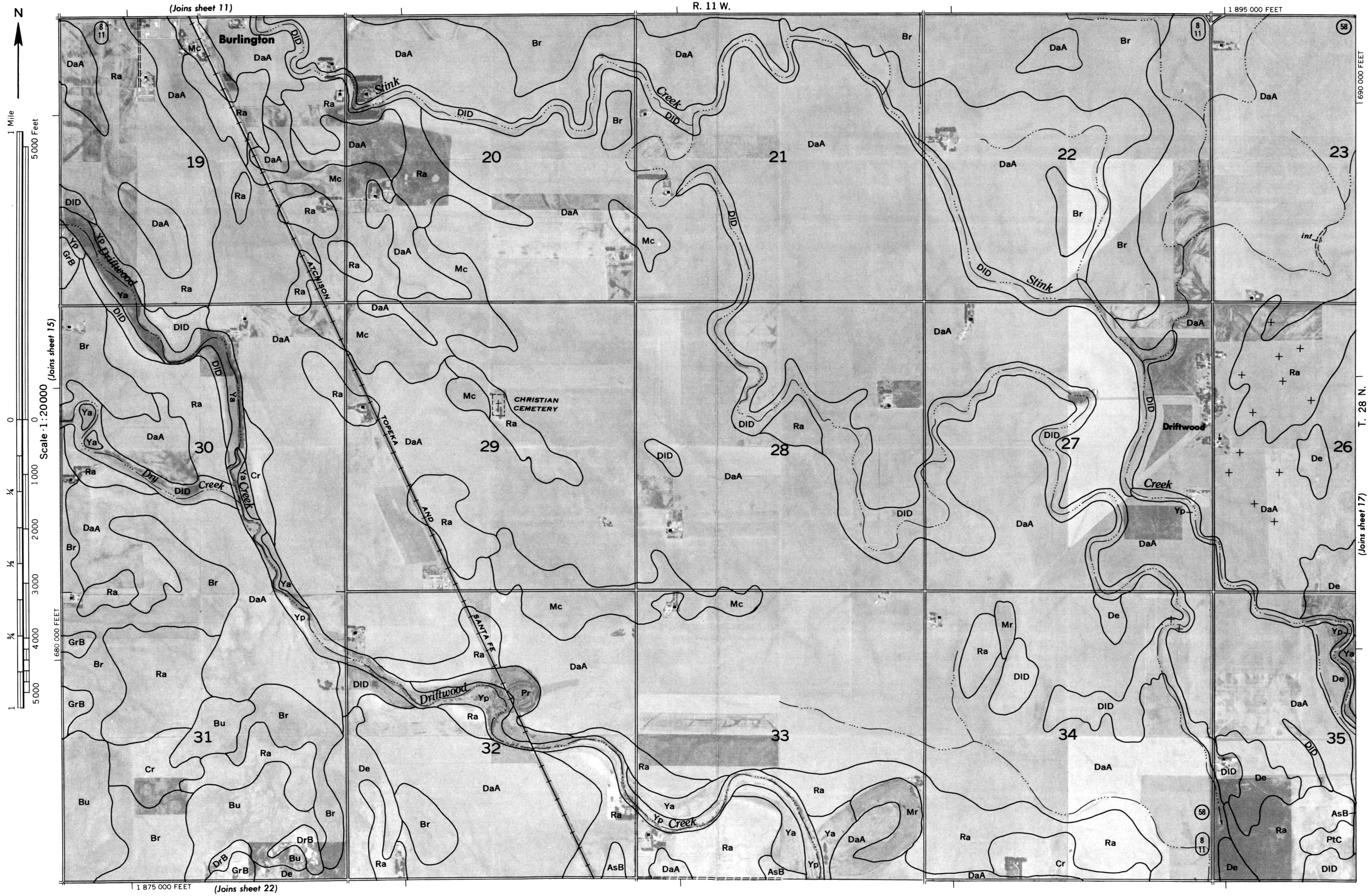
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

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ALFALFA COUNTY, OKLAHOMA NO. 17

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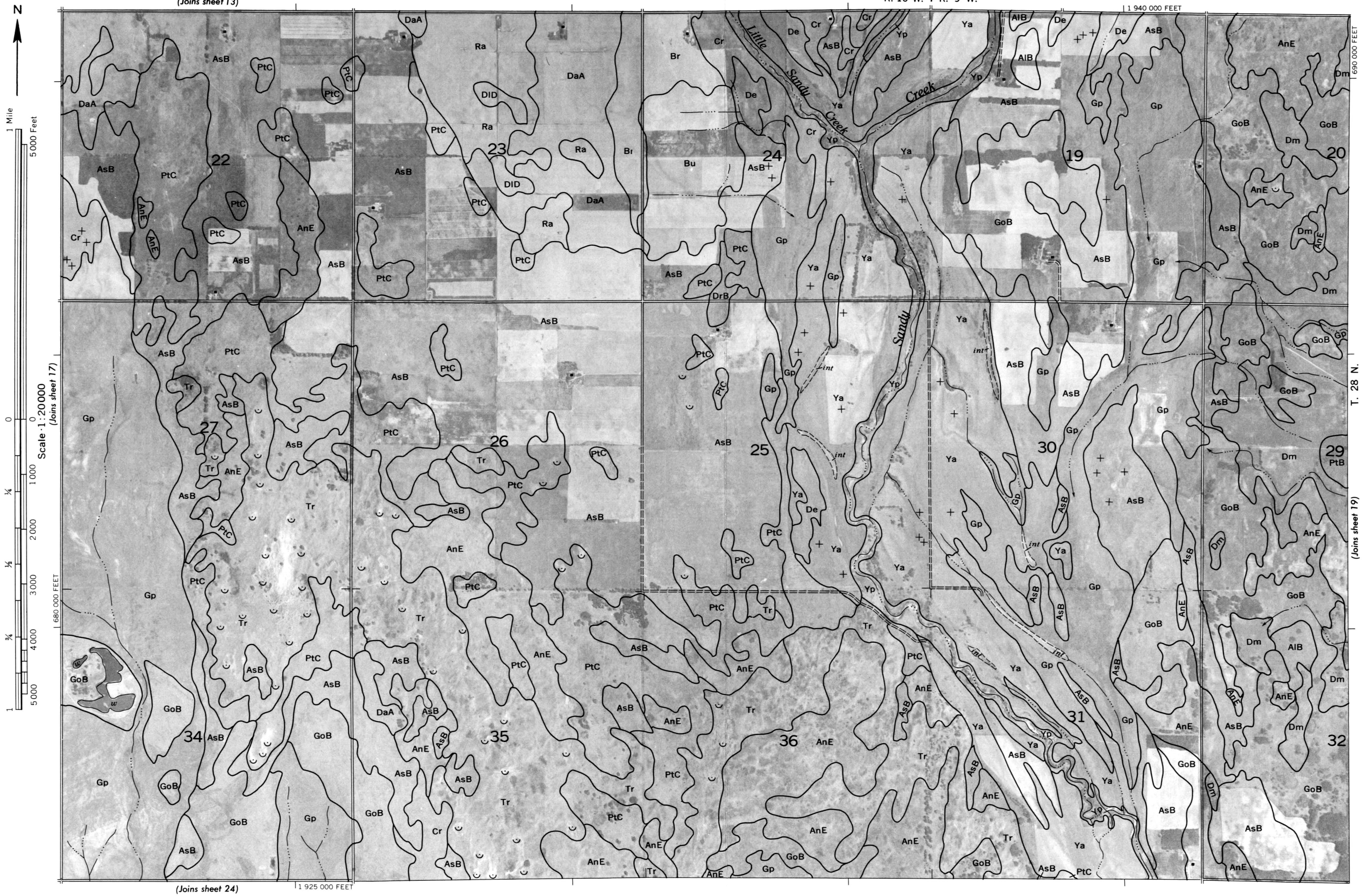
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 18



Land division corners are approximately positioned on this map.

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ALFALFA COUNTY, OKLAHOMA NO. 19

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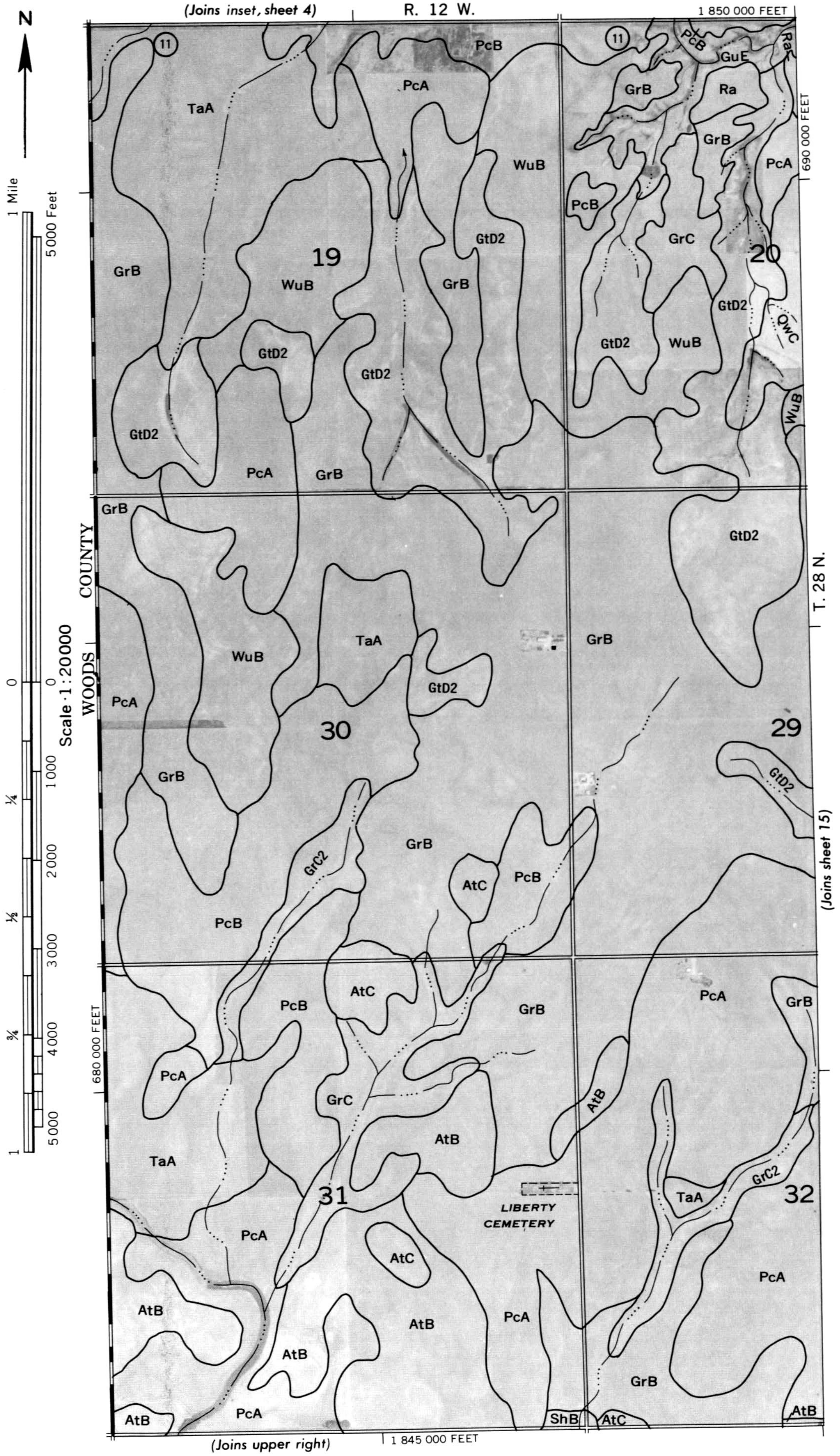
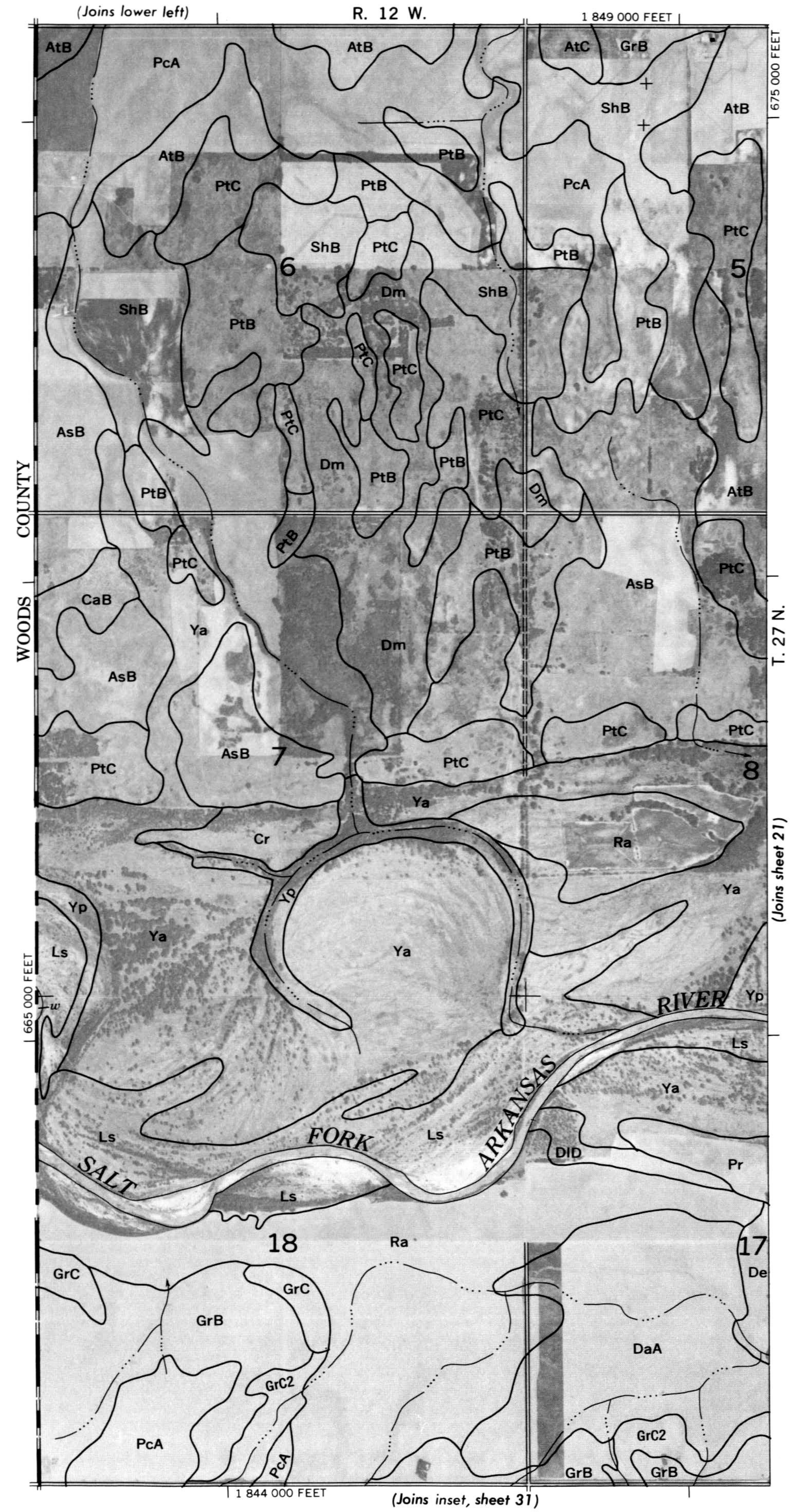
ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 20





Land division corners are approximately positioned on this map.

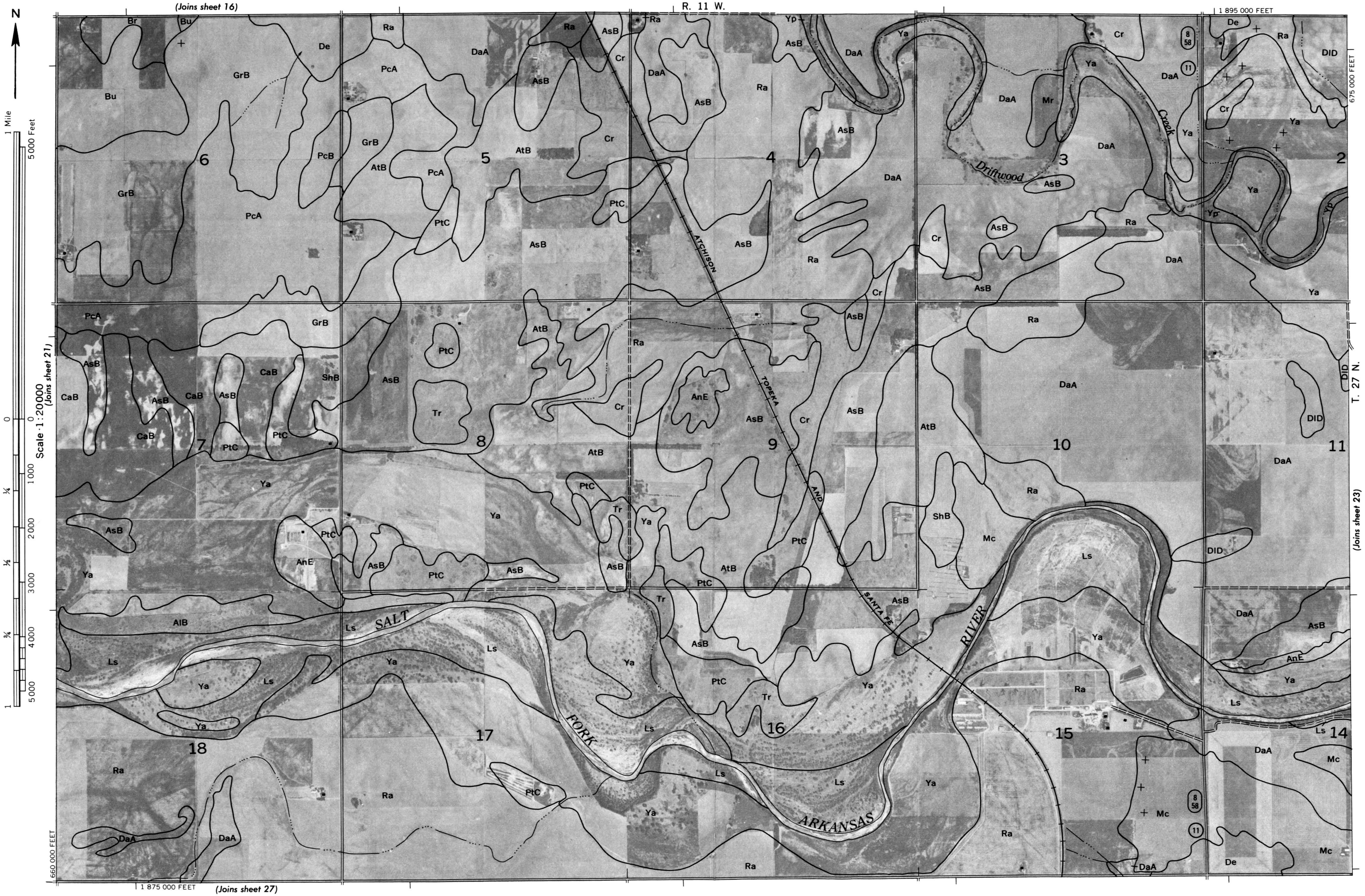
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 20

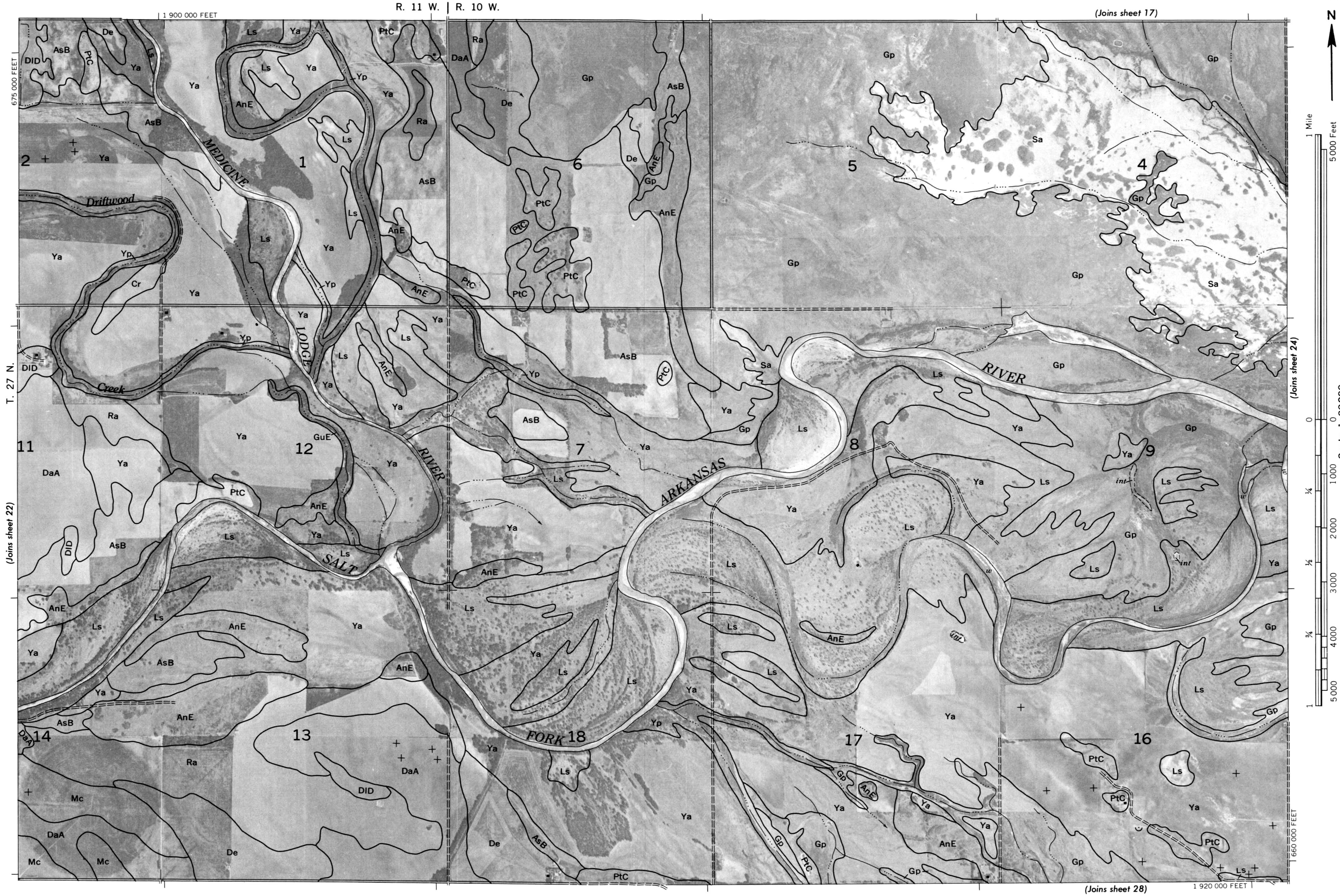
ALFALFA COUNTY, OKLAHOMA NO. 21

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

23



ALFALFA COUNTY, OKLAHOMA NO. 23

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 24

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

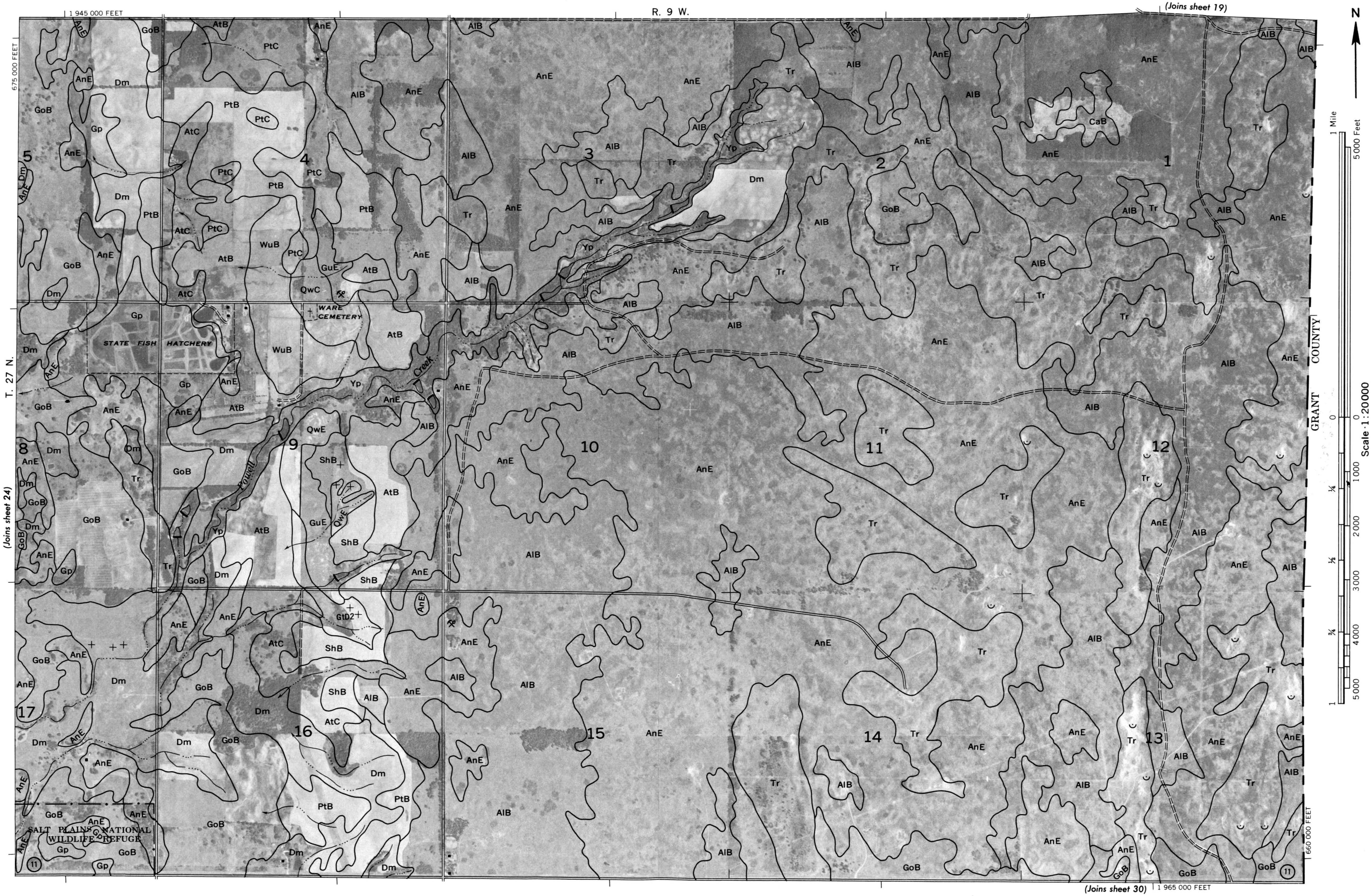
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 24

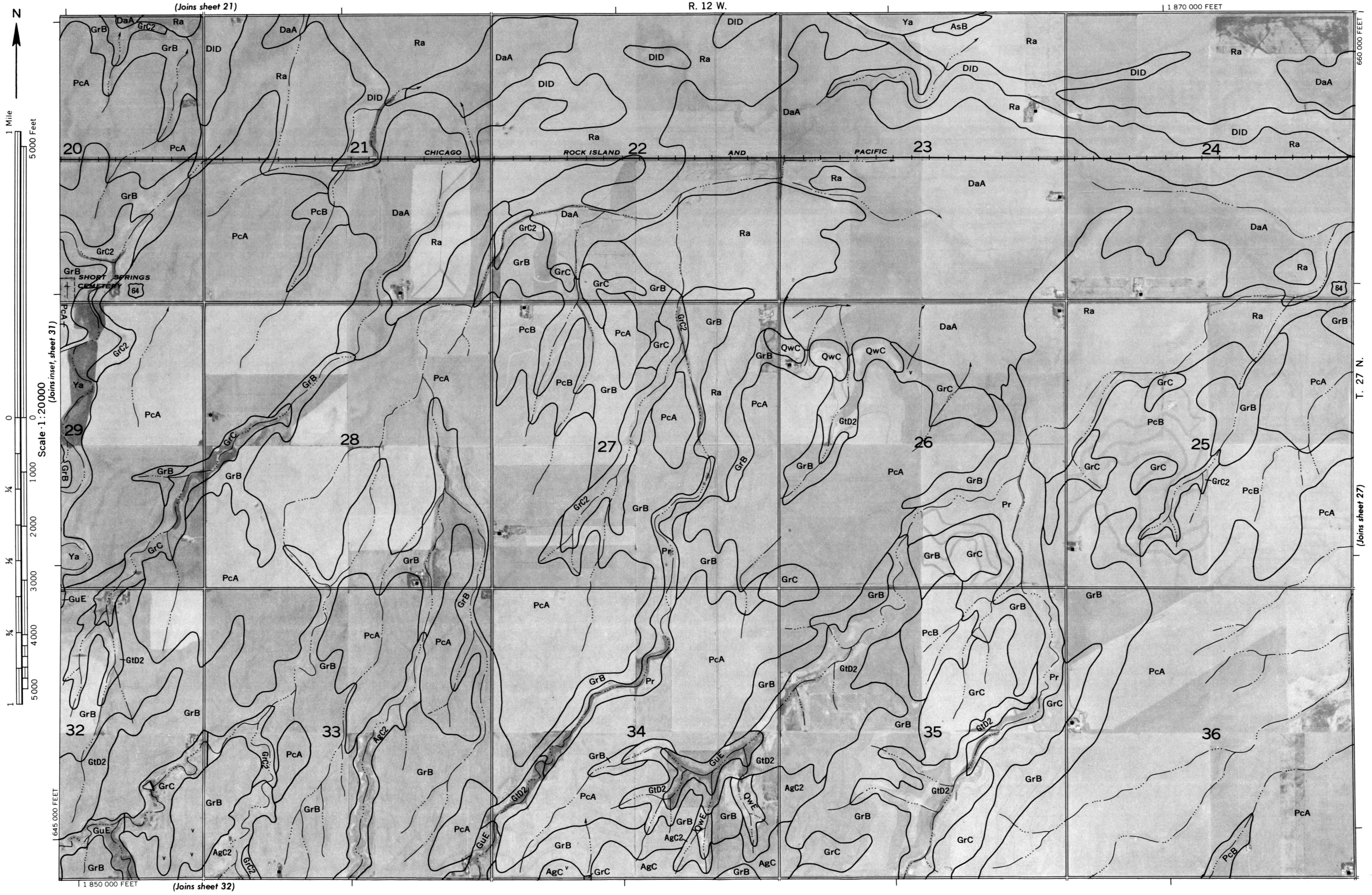
25

ALFALFA COUNTY, OKLAHOMA NO. 25

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 26



Land division corners are approximately positioned on this map.

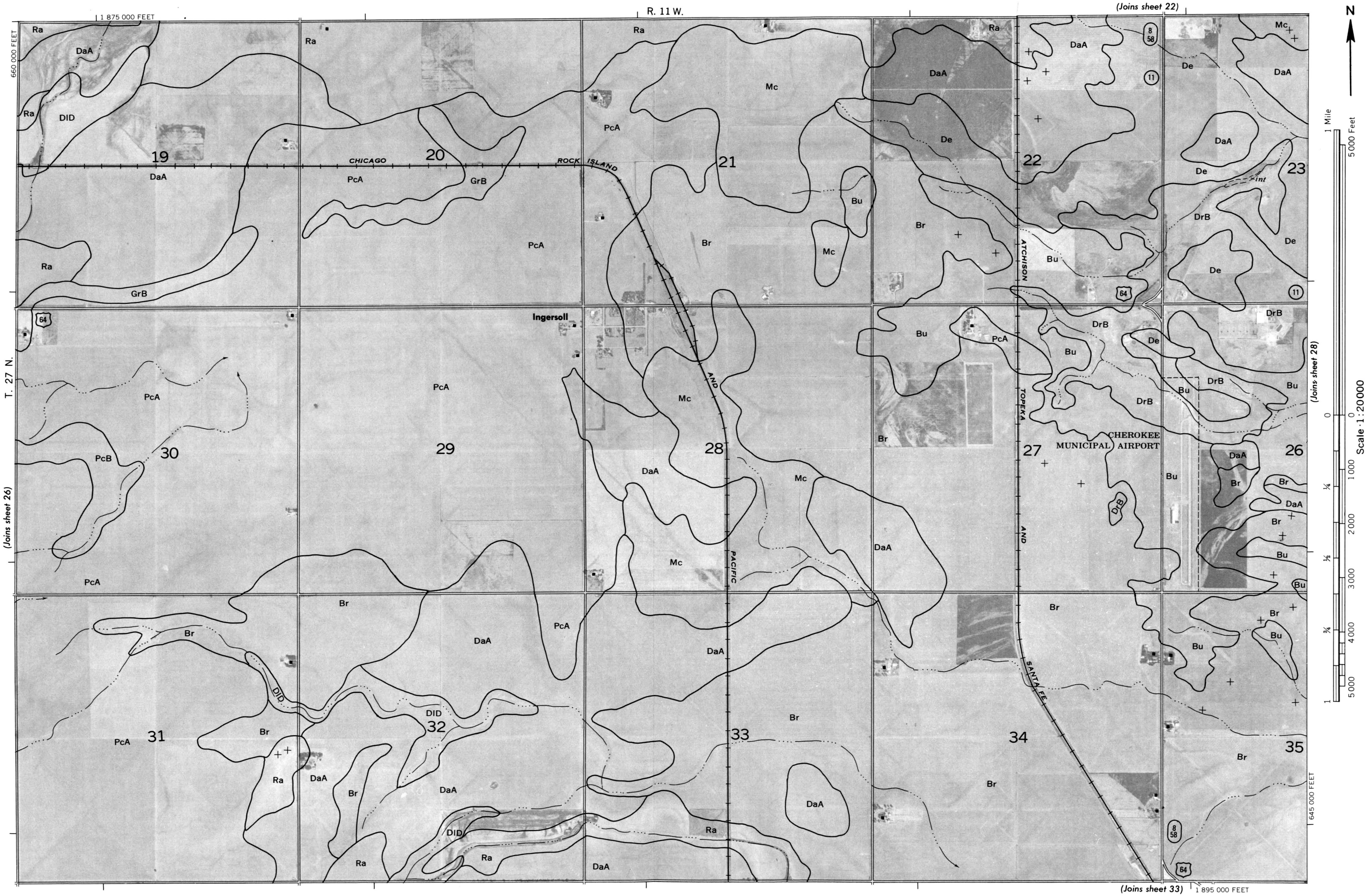
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

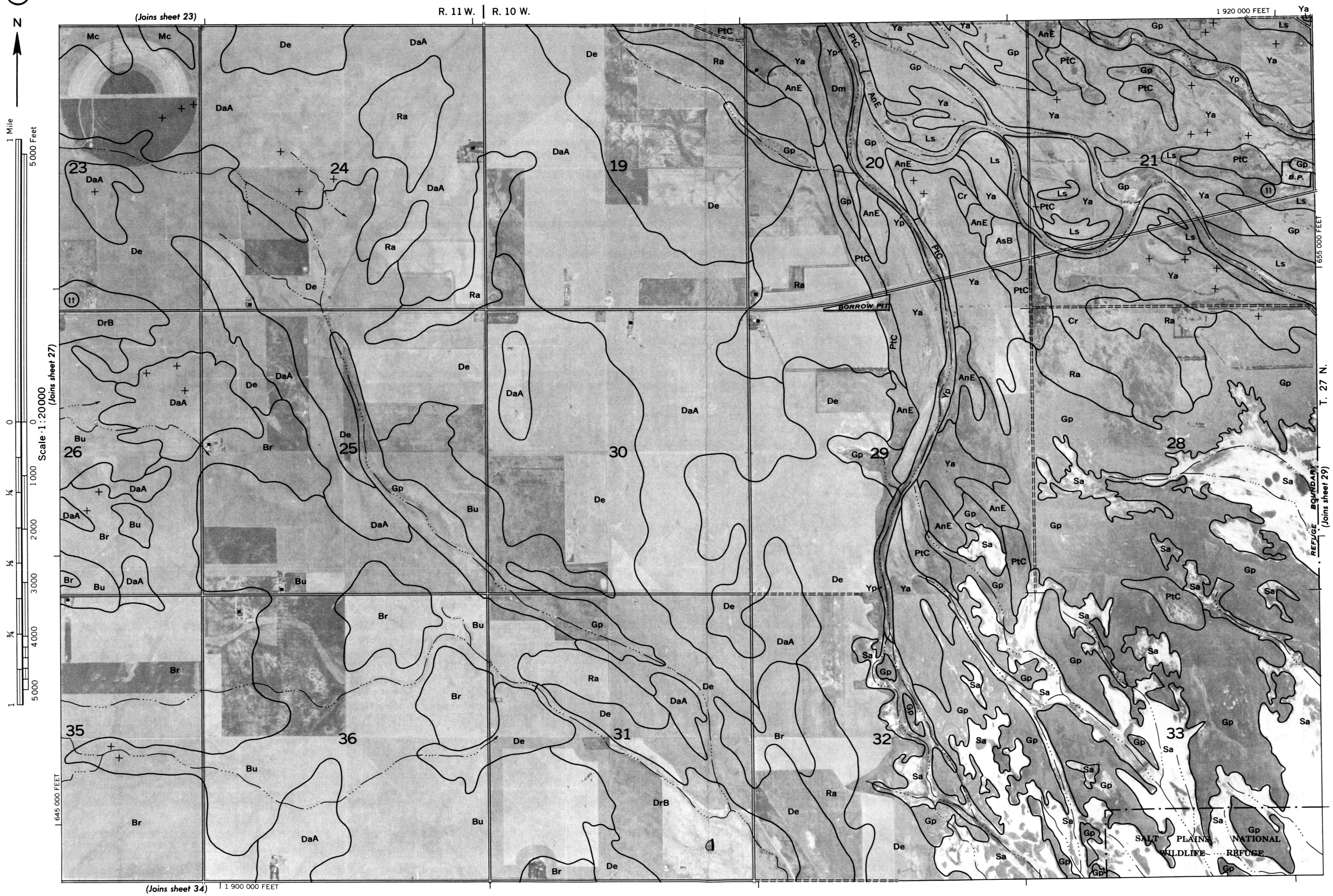
ALFALFA COUNTY, OKLAHOMA NO. 26

ALFALFA COUNTY, OKLAHOMA NO. 27

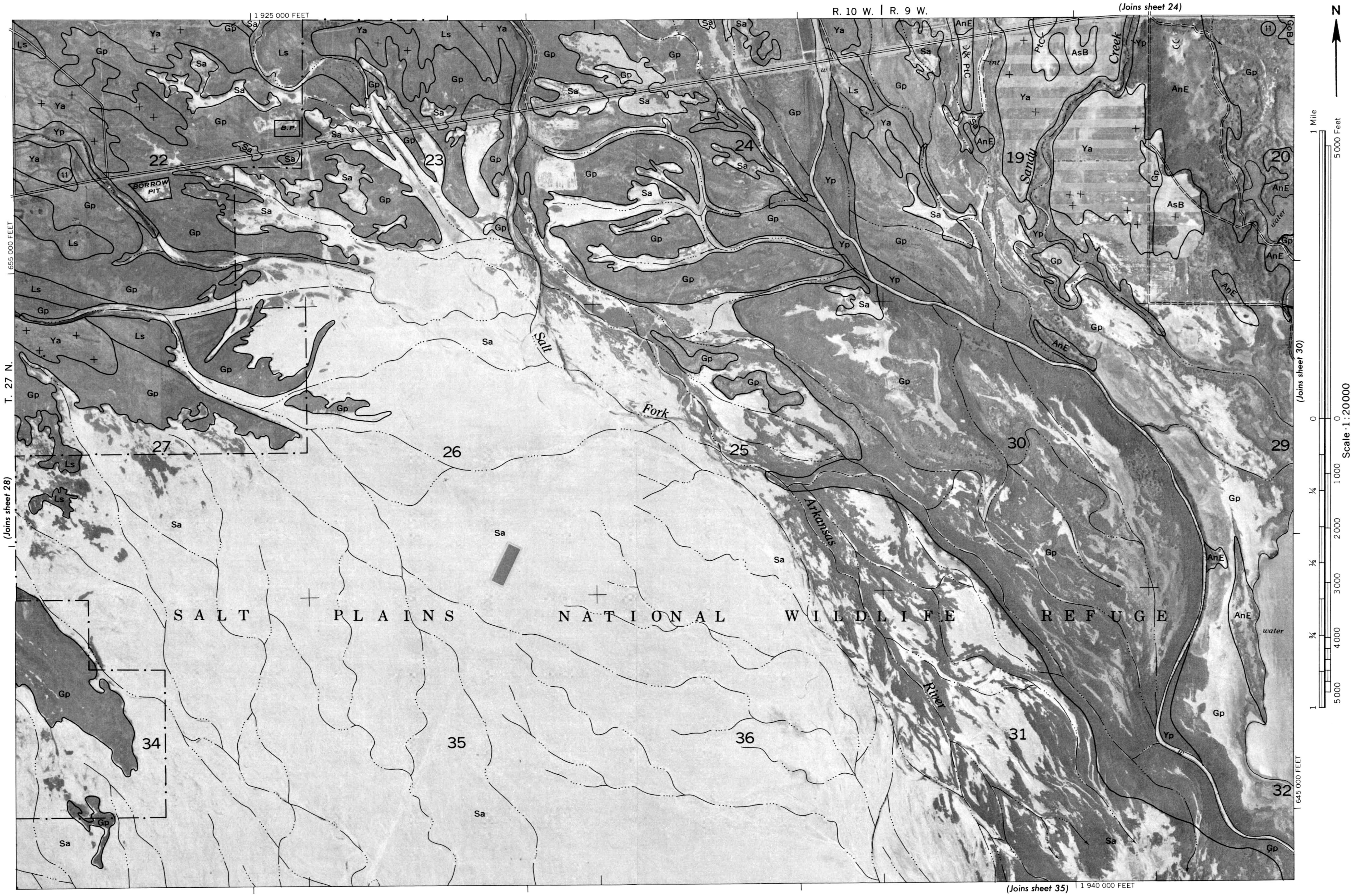
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 28



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.



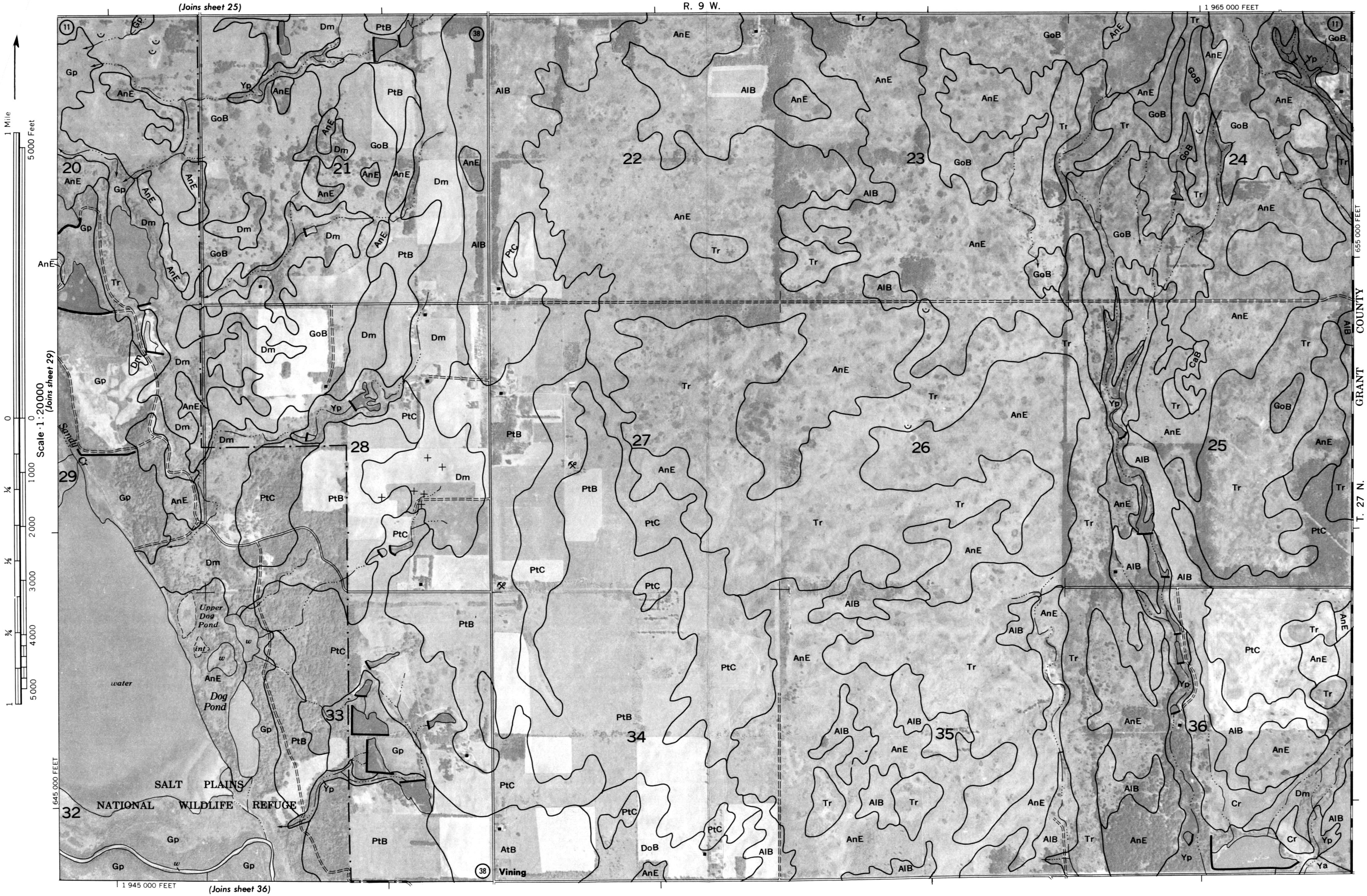
ALFALFA COUNTY, OKLAHOMA NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 30



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

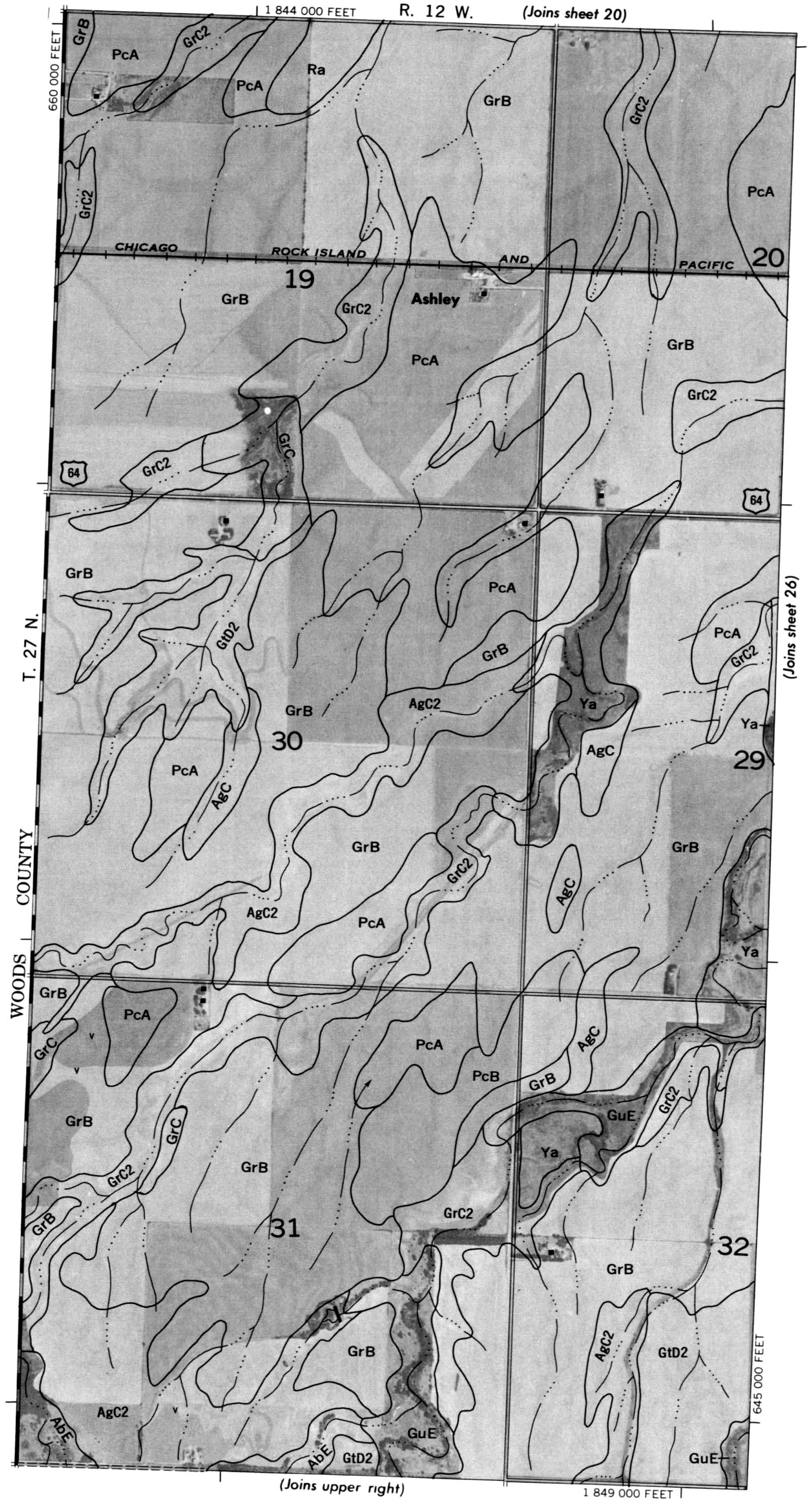
ALFALFA COUNTY, OKLAHOMA NO. 30

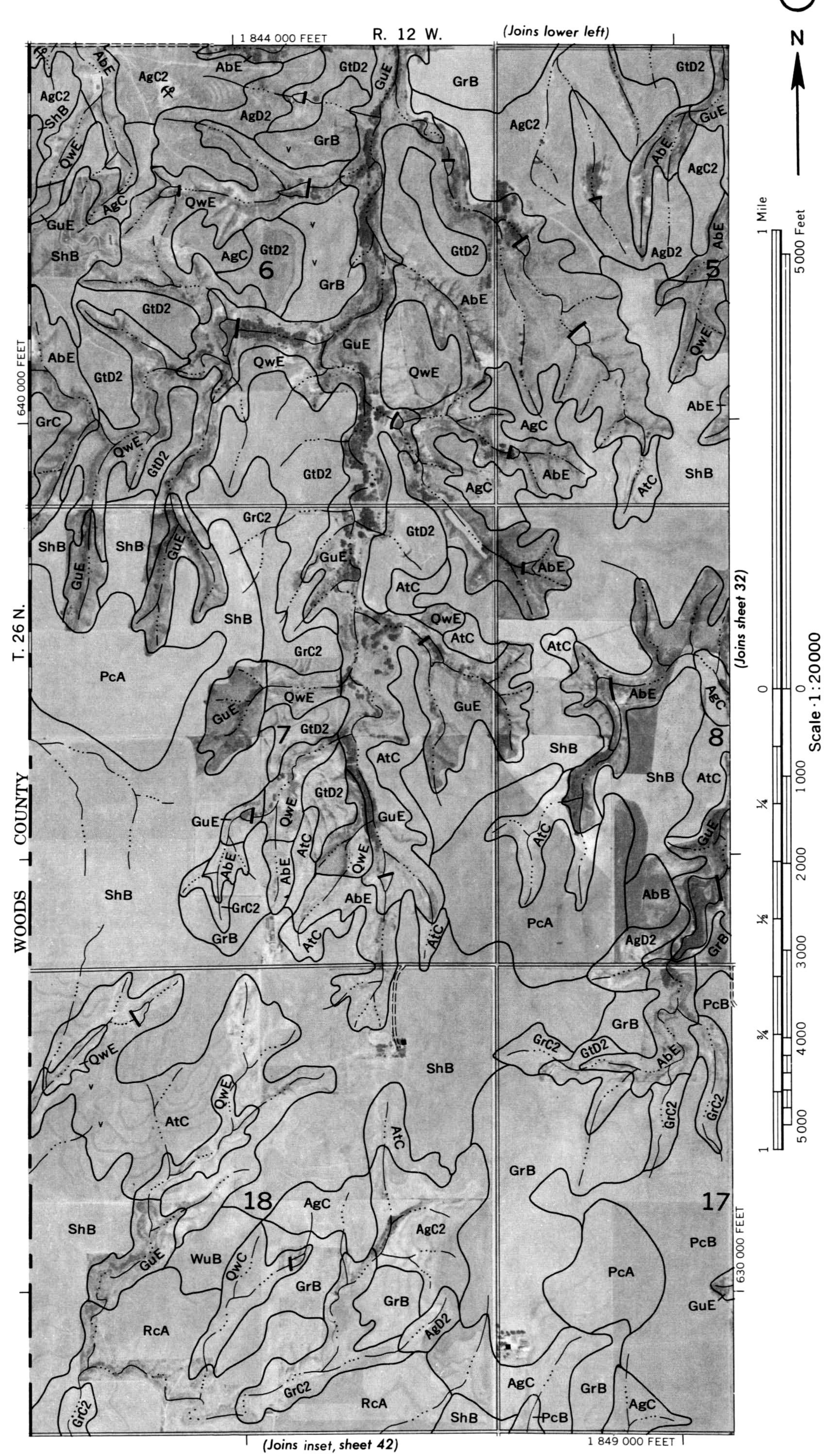
ALFALFA COUNTY, OKLAHOMA NO. 31

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station

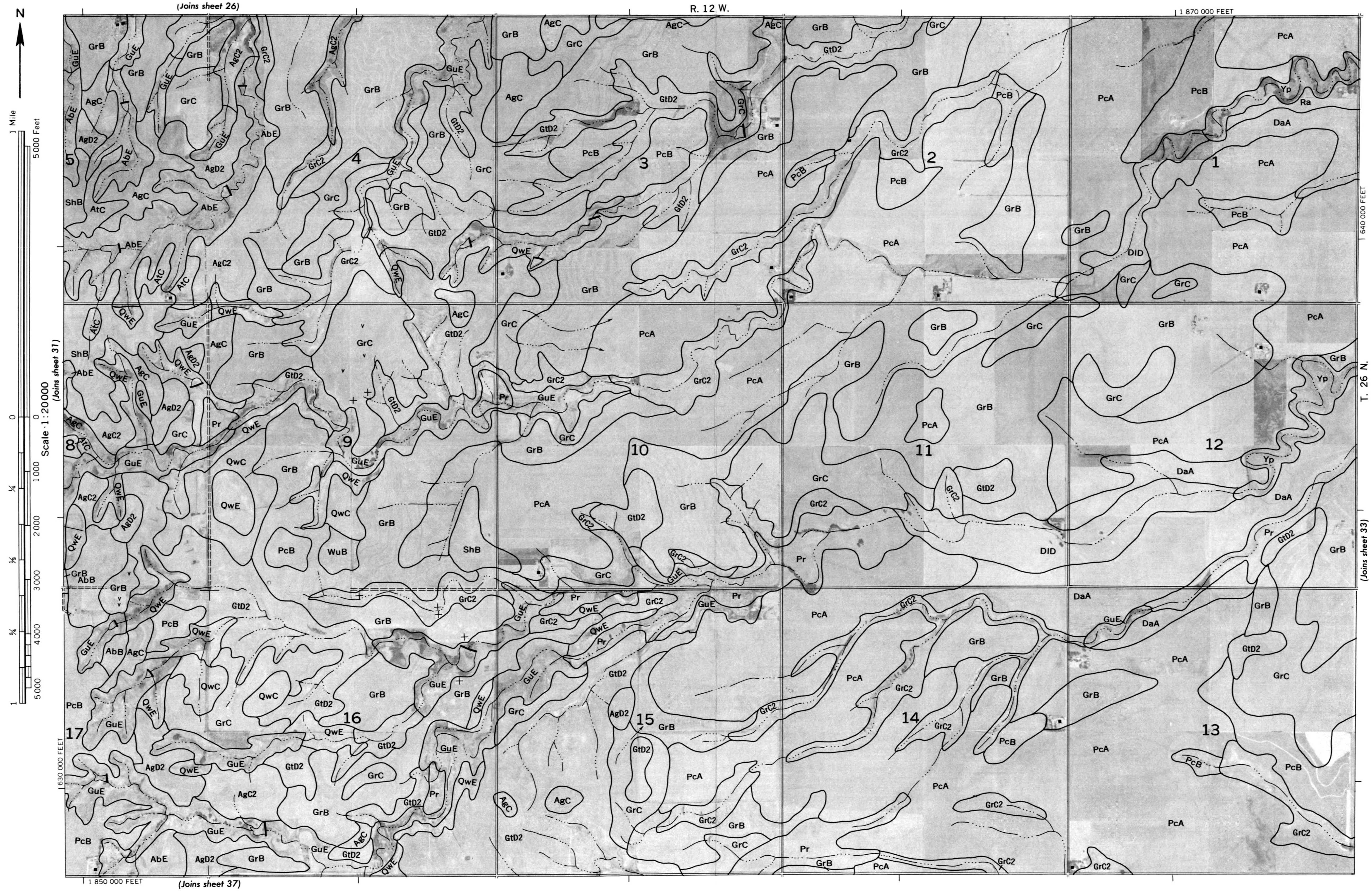
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.





ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 32



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
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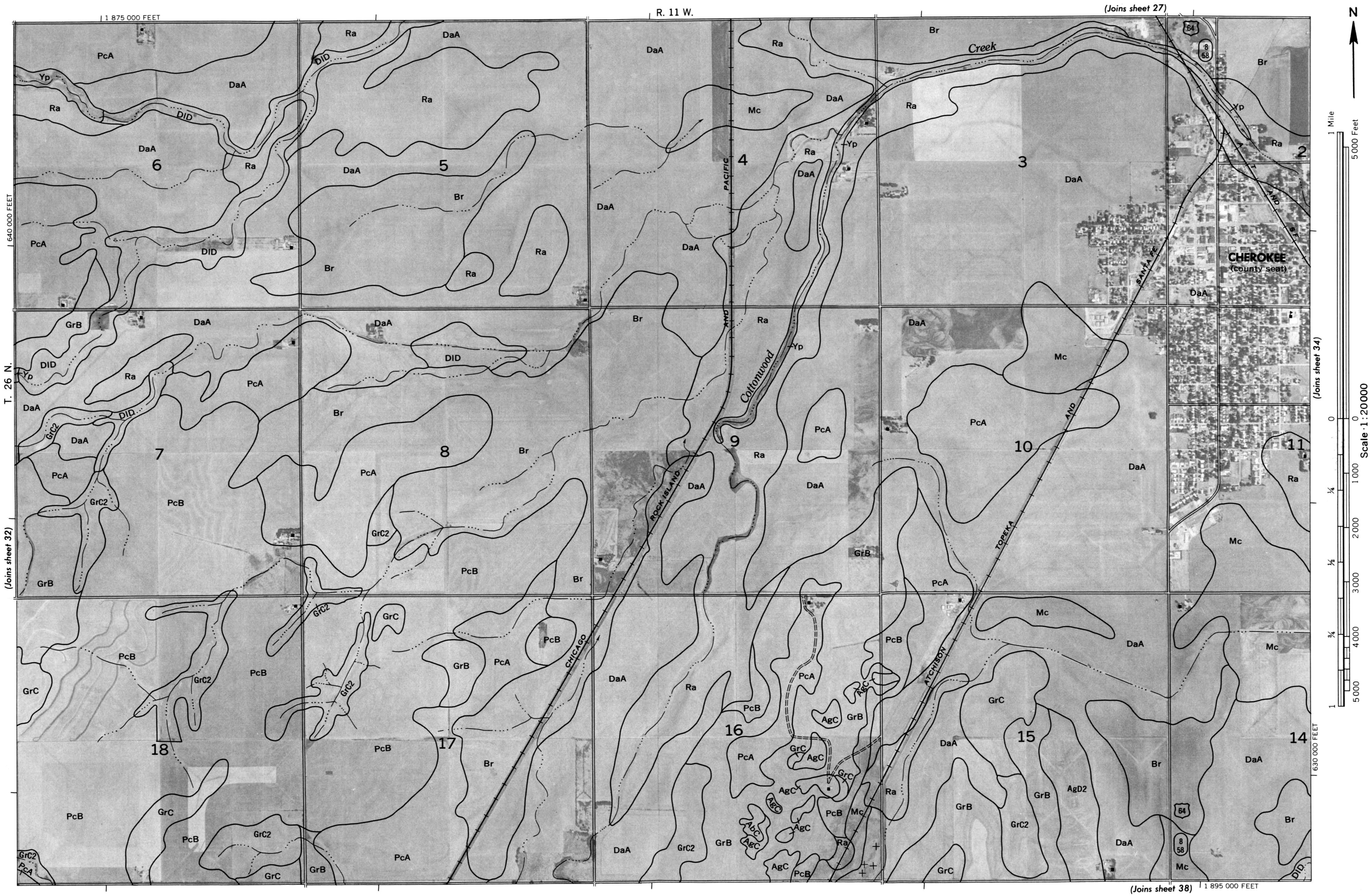
ALFALFA COUNTY, OKLAHOMA NO. 32

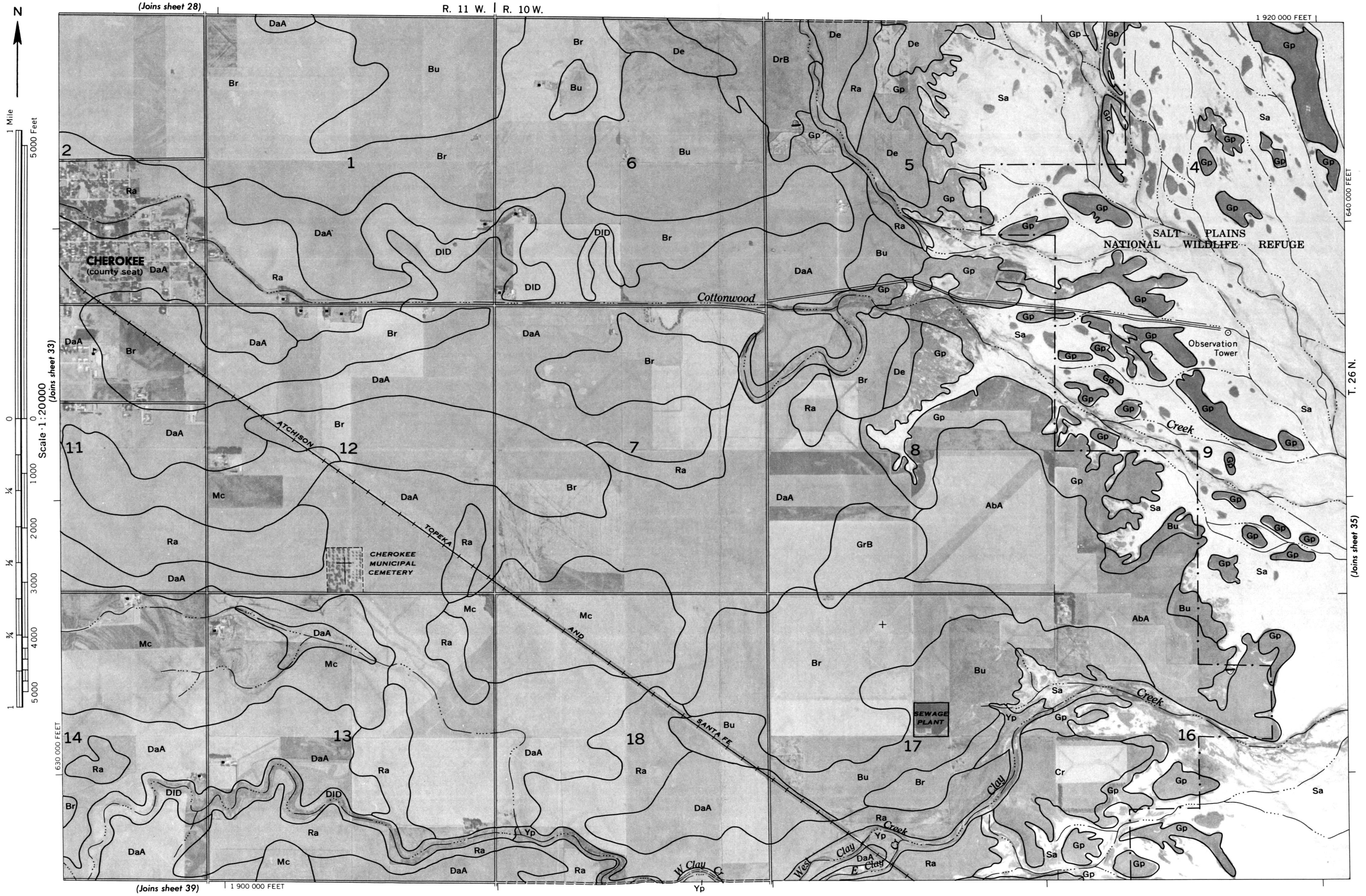
ALFALFA COUNTY, OKLAHOMA NO. 33

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



(34)

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 34

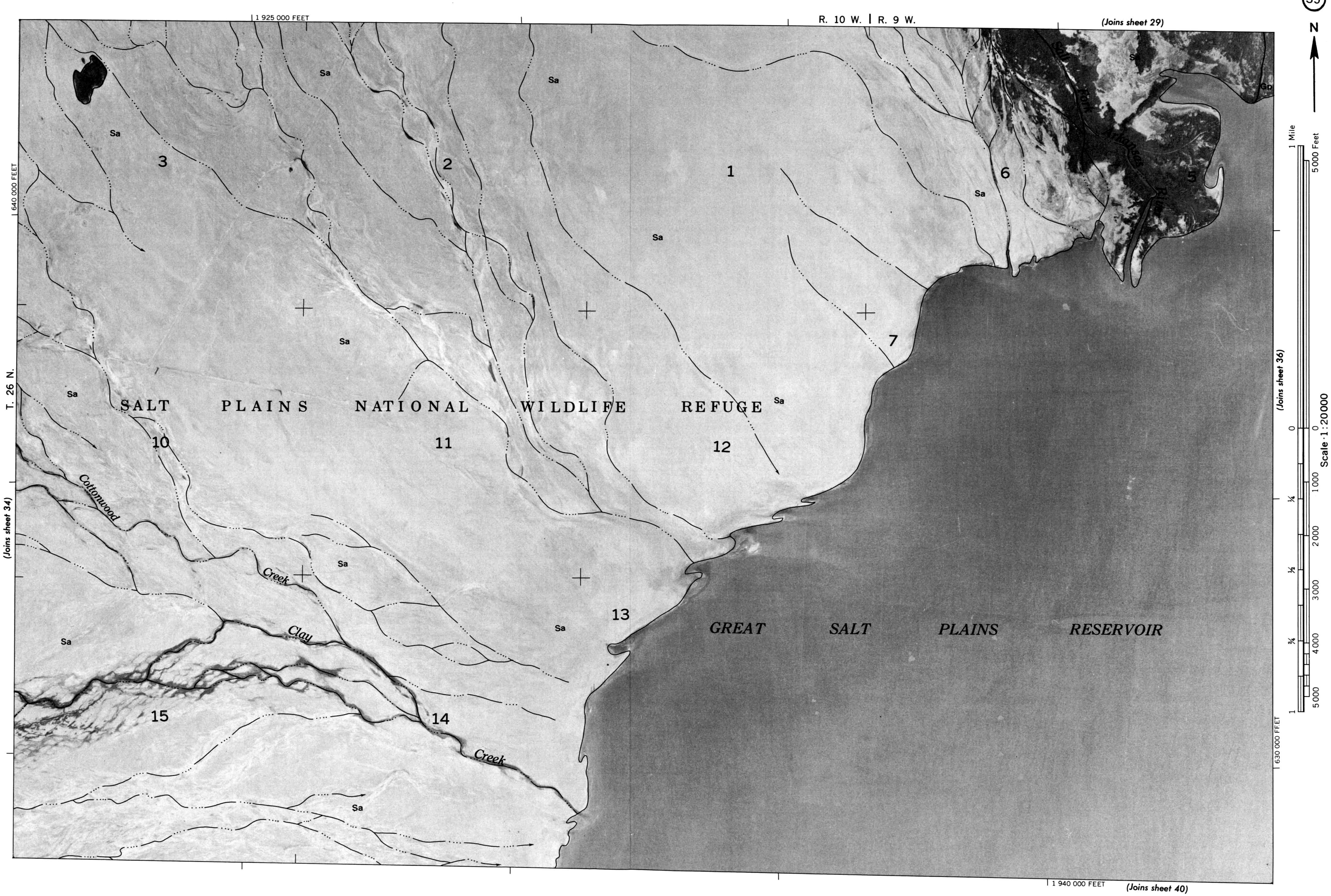


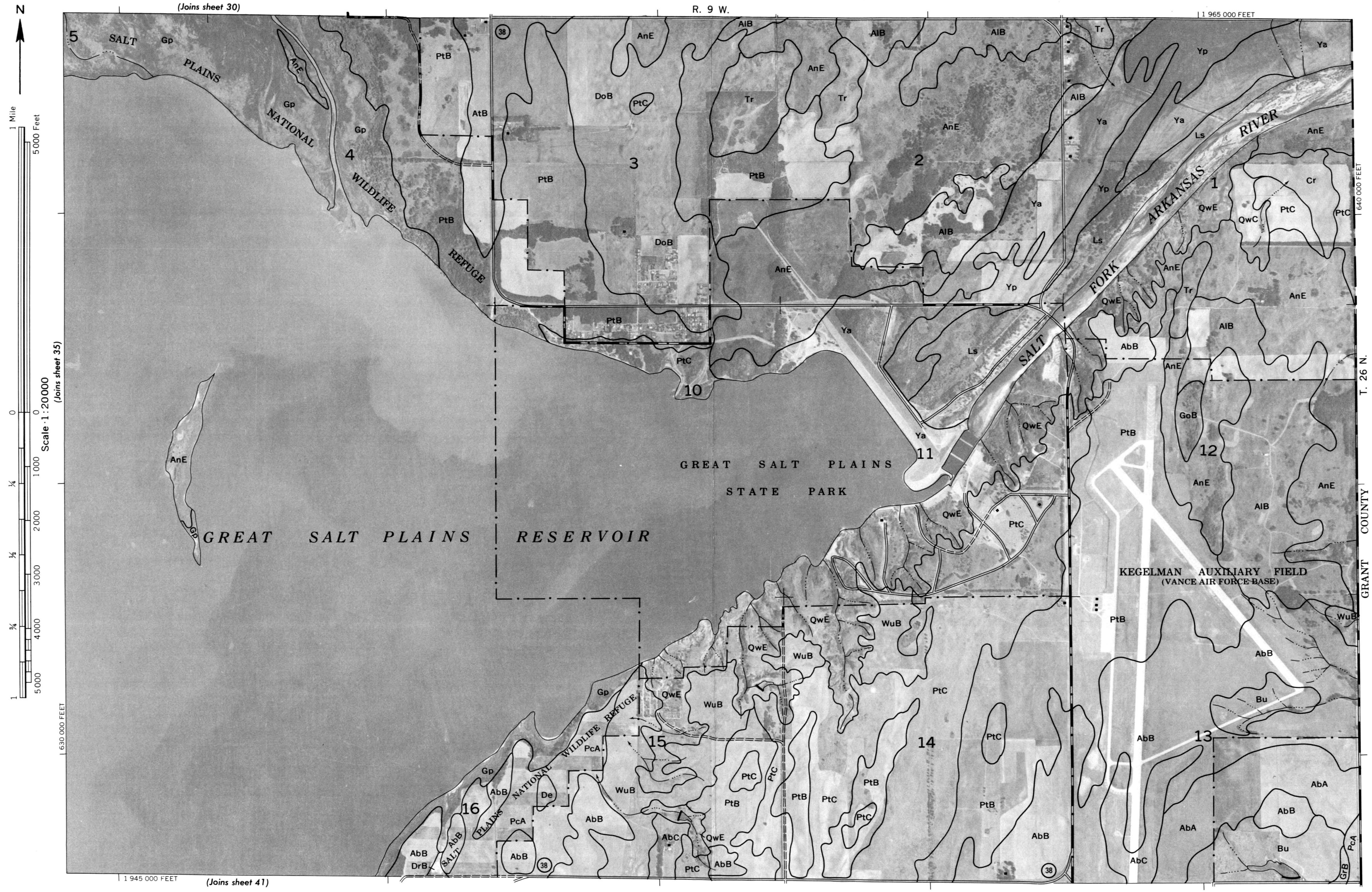
Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 34

ALFALFA COUNTY, OKLAHOMA NO. 35

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.





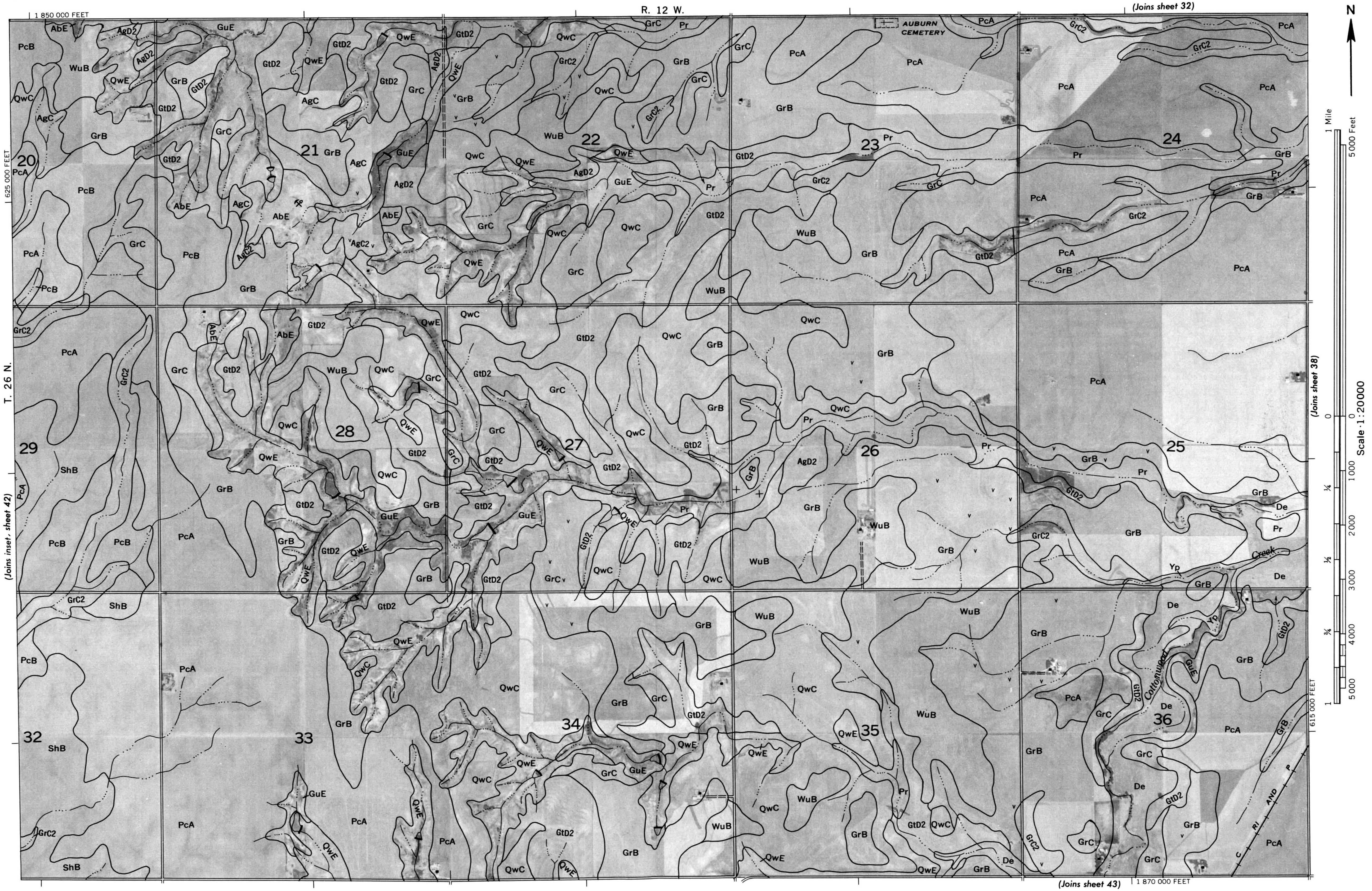
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA NO. 36

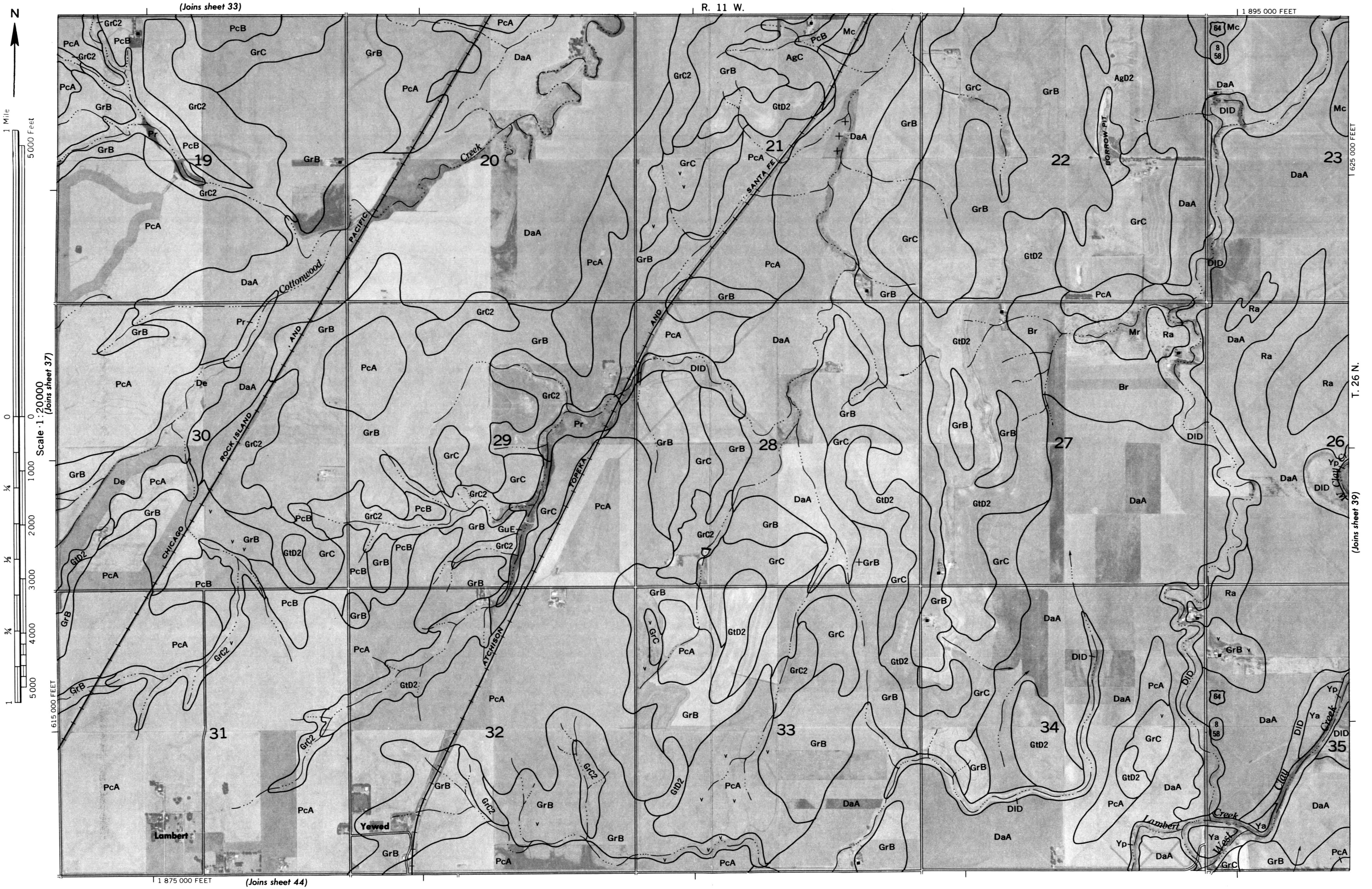
37

ALFALFA COUNTY, OKLAHOMA NO. 37

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



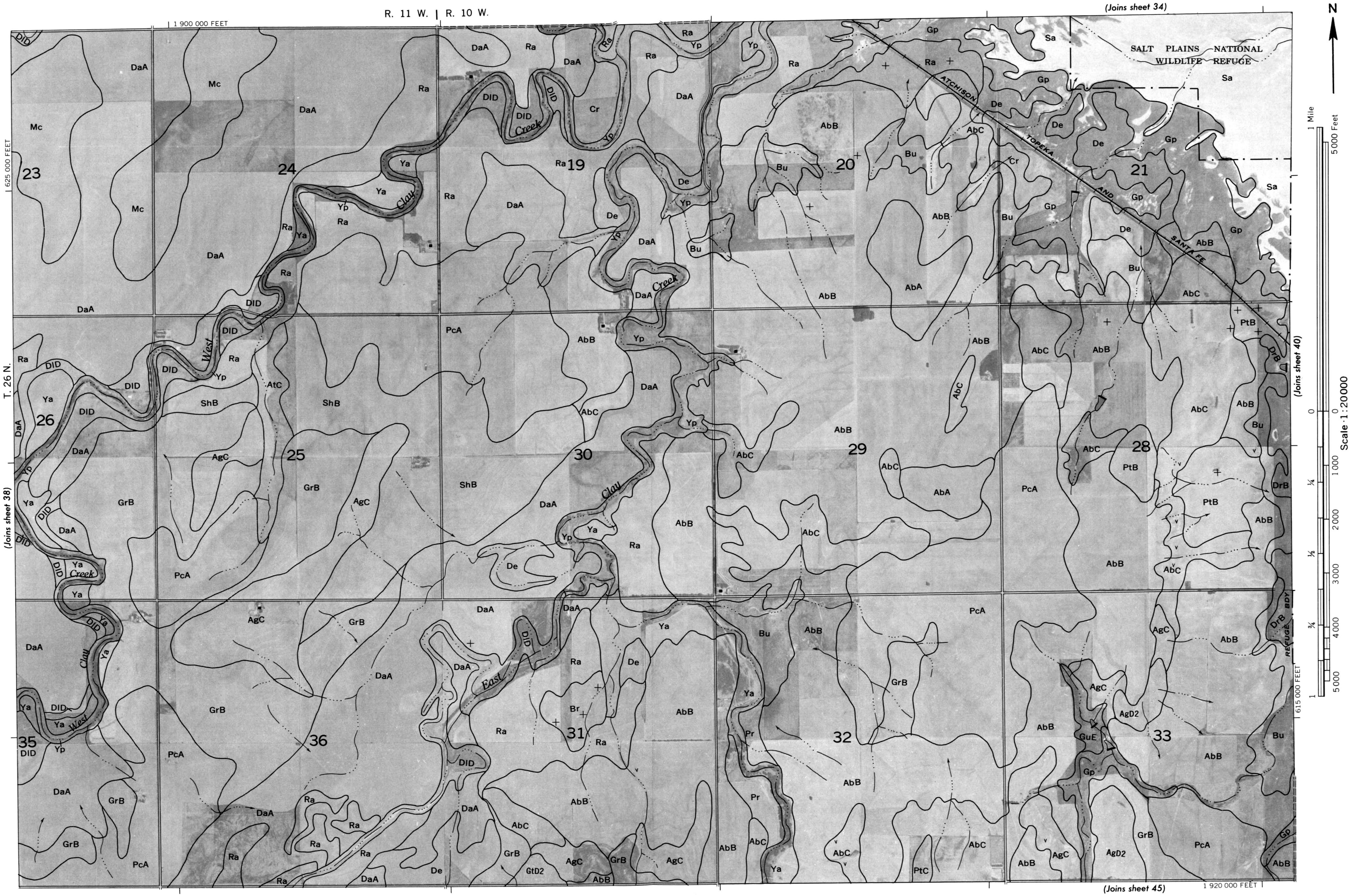
ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 38



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

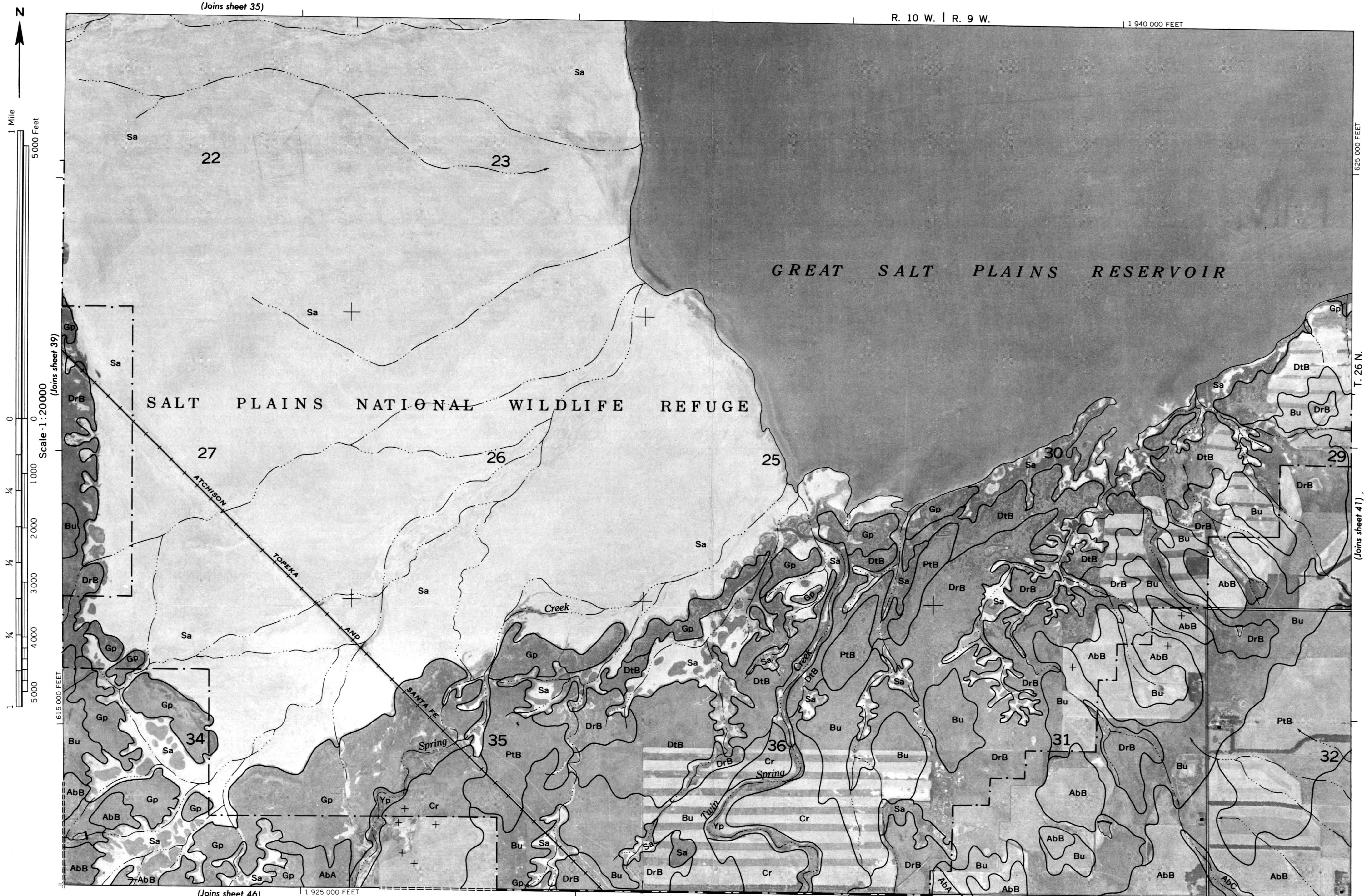
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.



ALFALFA COUNTY, OKLAHOMA NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 40

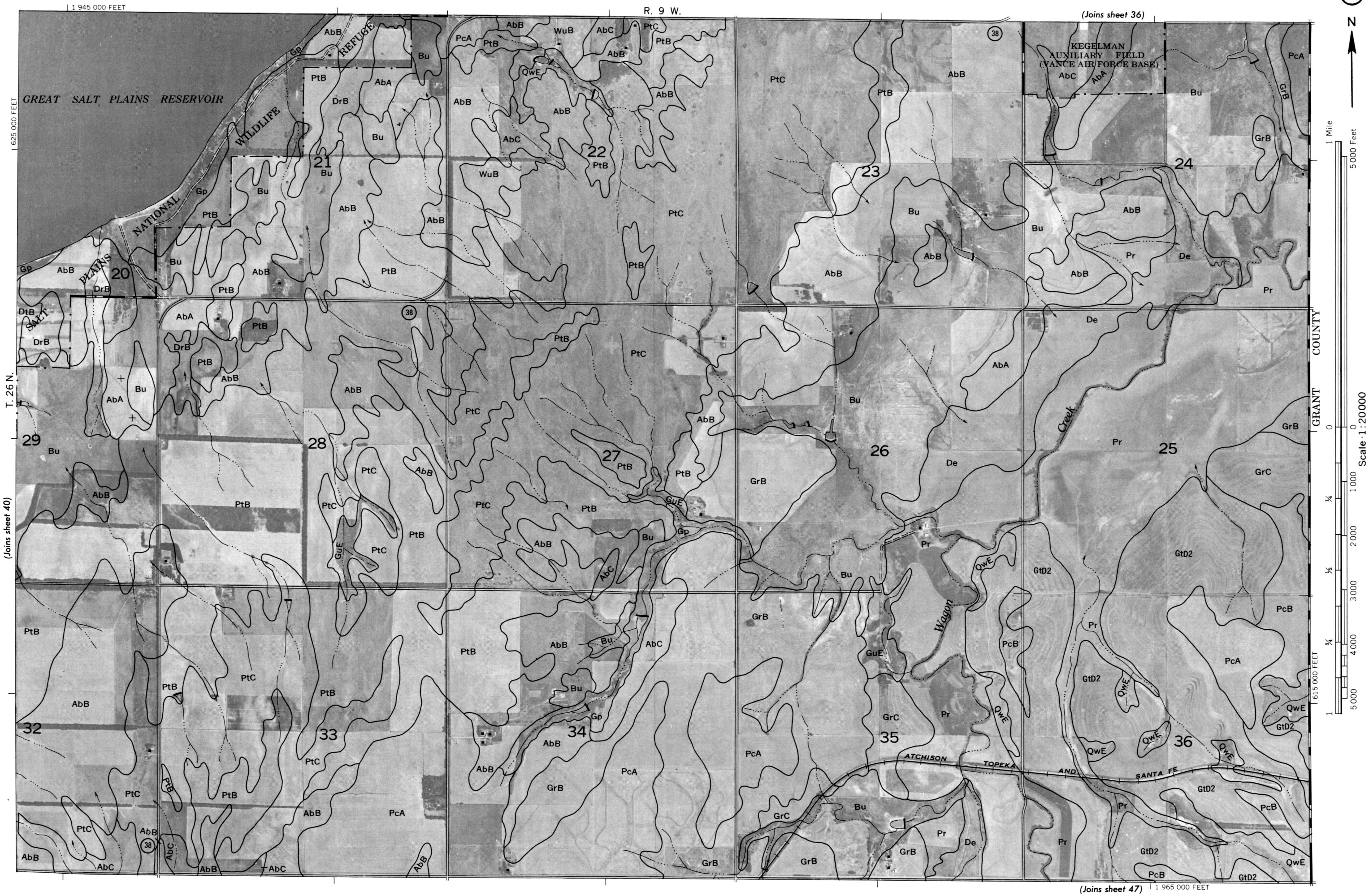


Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

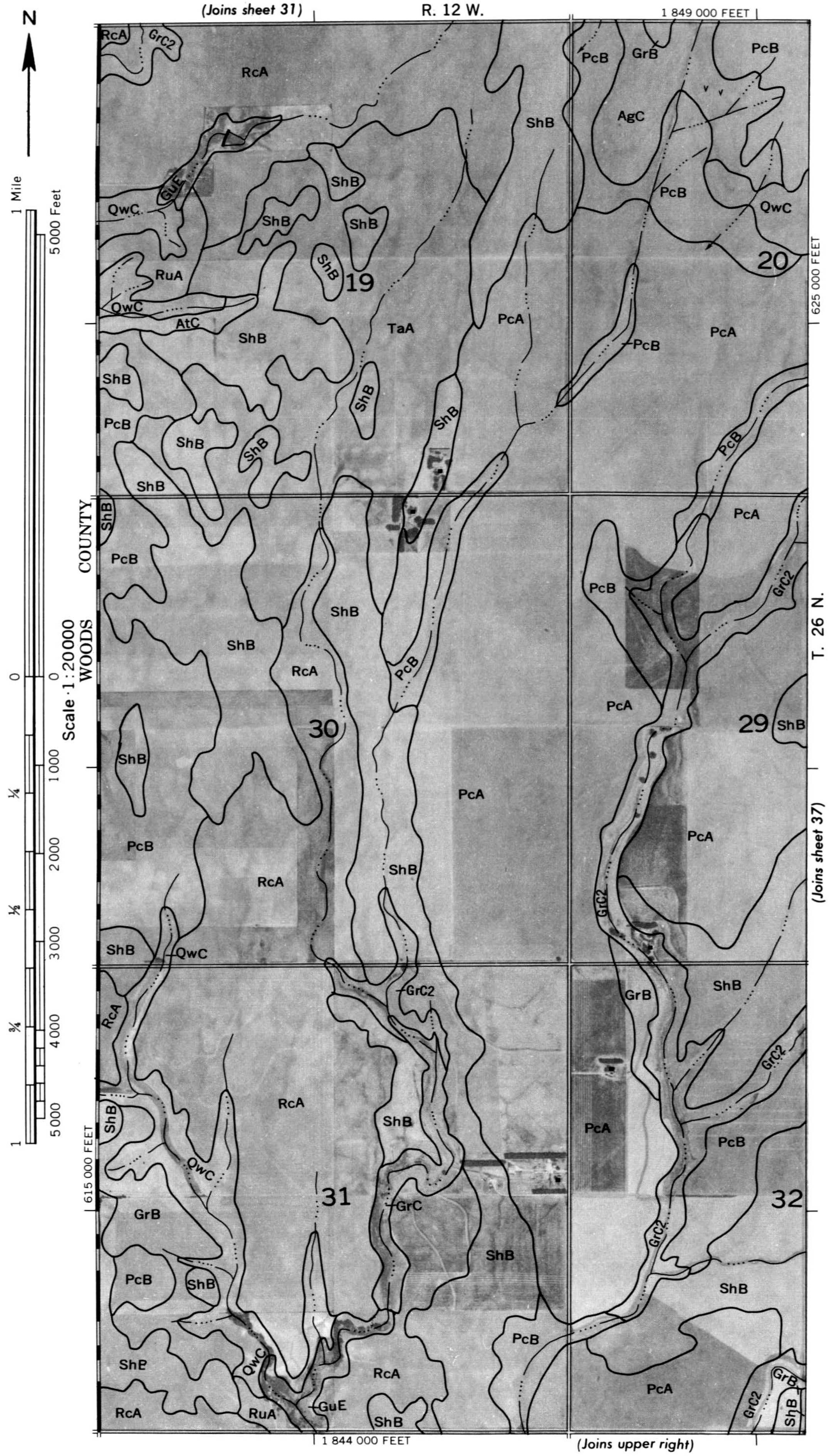
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

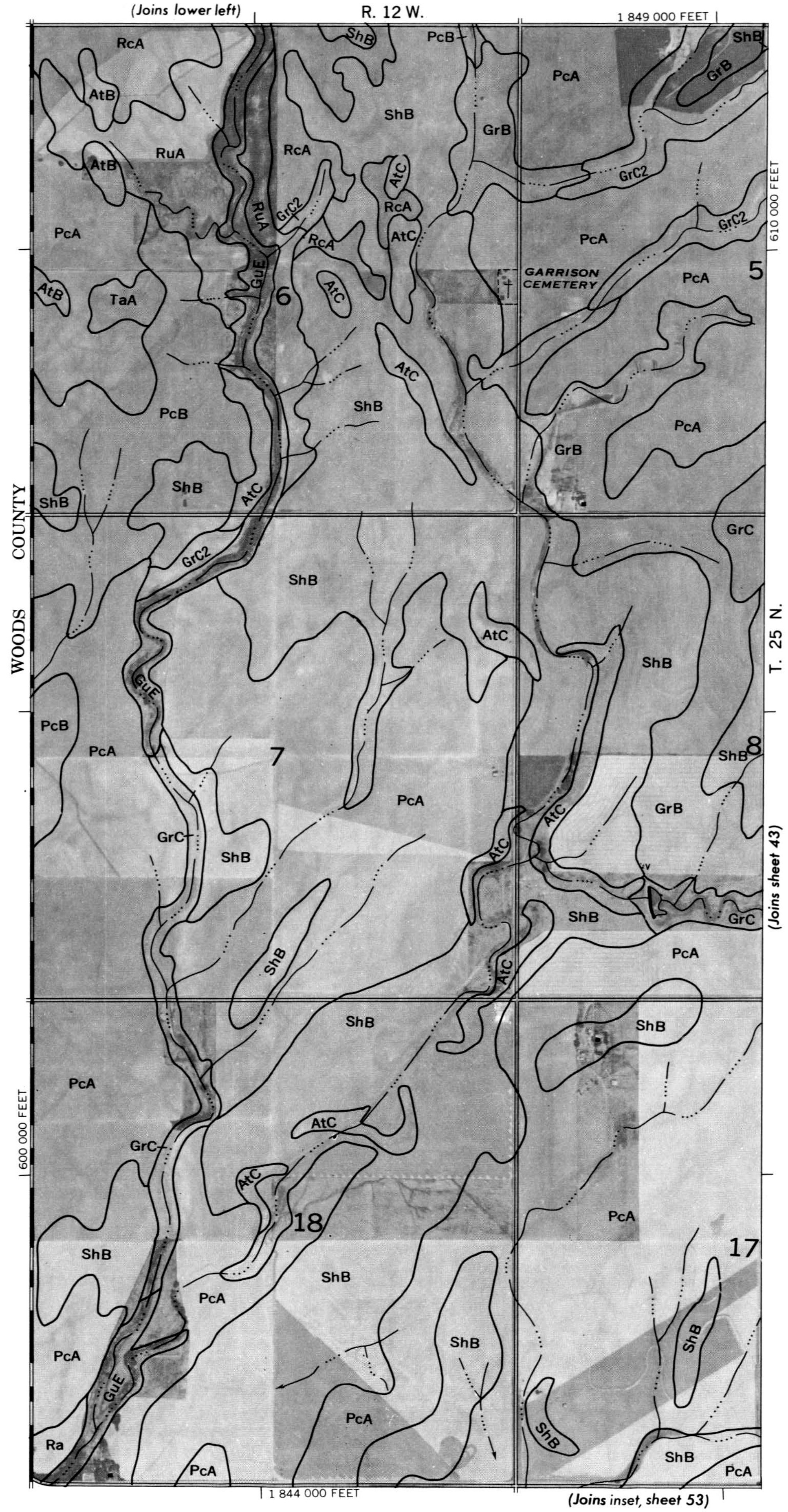
ALFALFA COUNTY, OKLAHOMA NO. 40



ALFALFA COUNTY, OKLAHOMA NO. 41

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

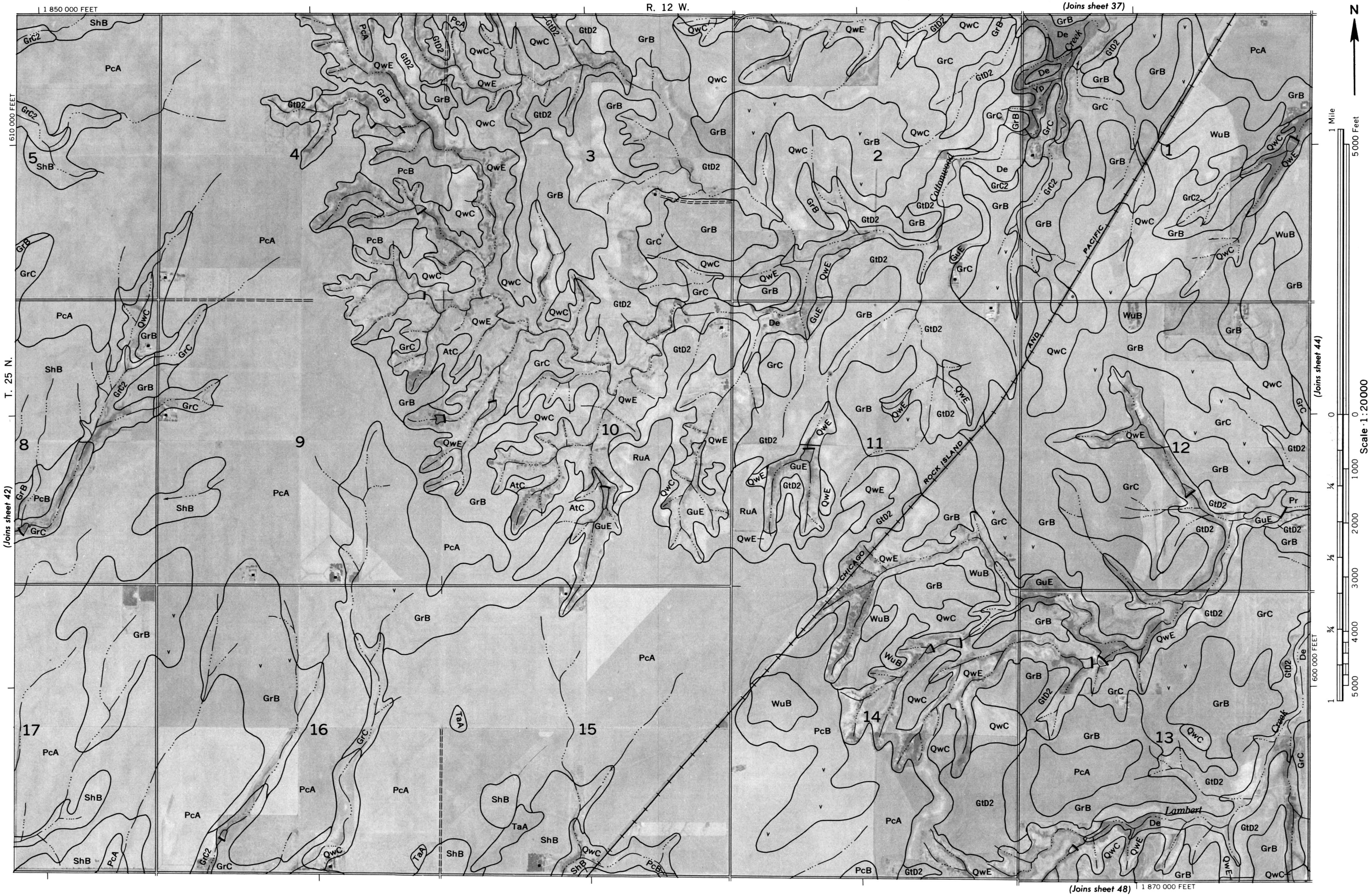




Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

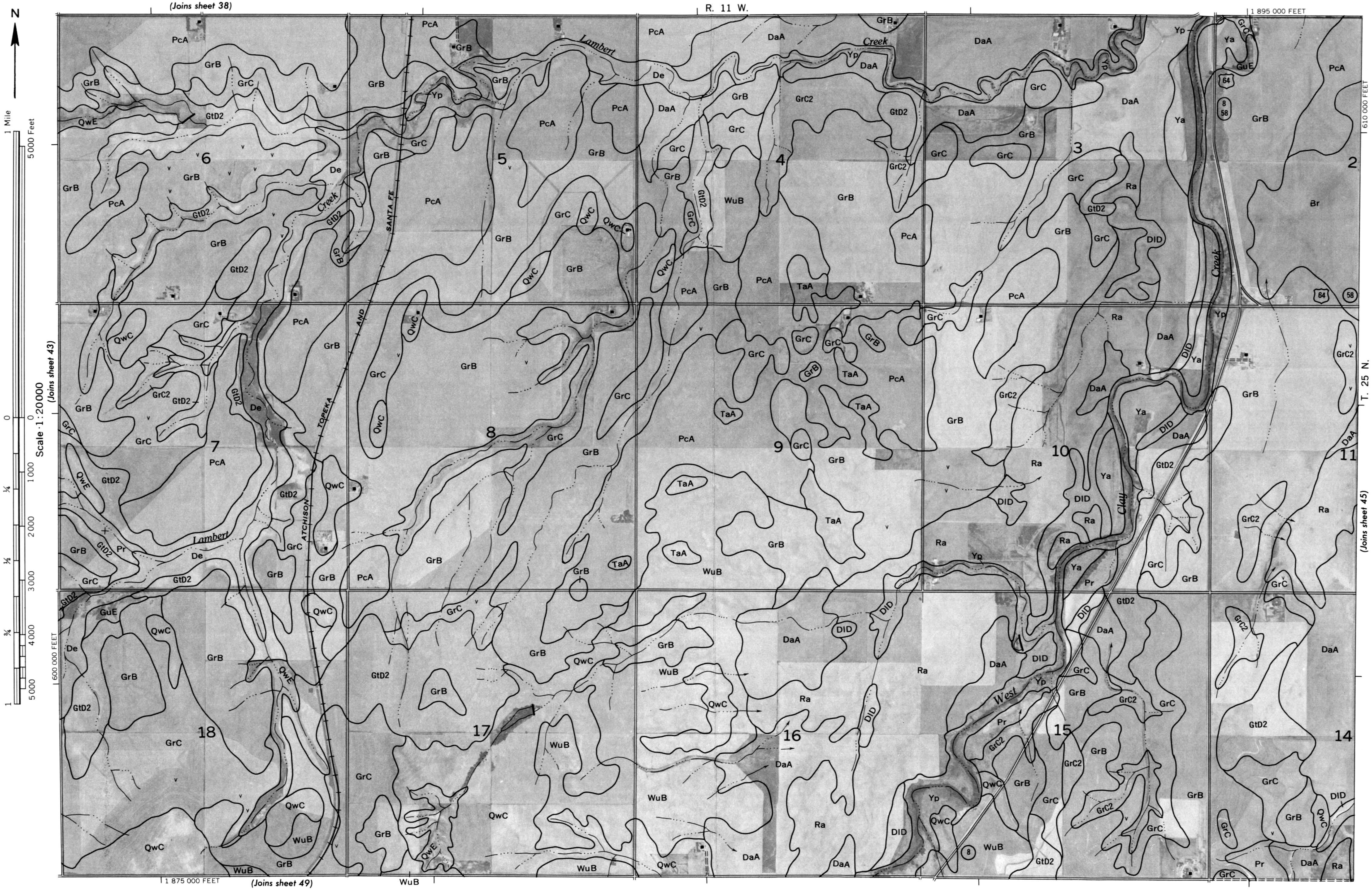
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.



ALFALFA COUNTY, OKLAHOMA NO. 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 44



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

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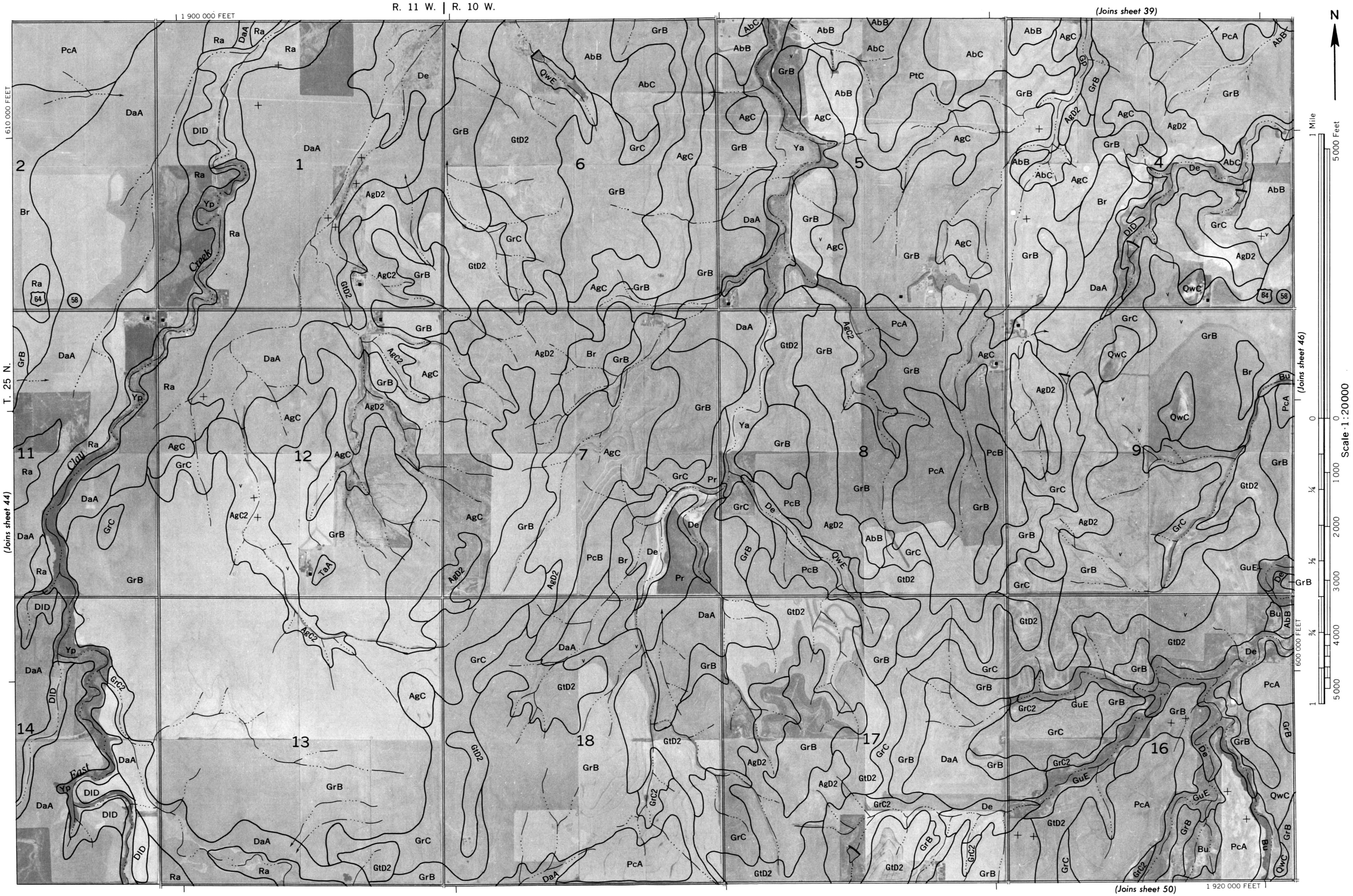
ALFALFA COUNTY, OKLAHOMA NO. 44



ALFALFA COUNTY, OKLAHOMA NO. 45

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.

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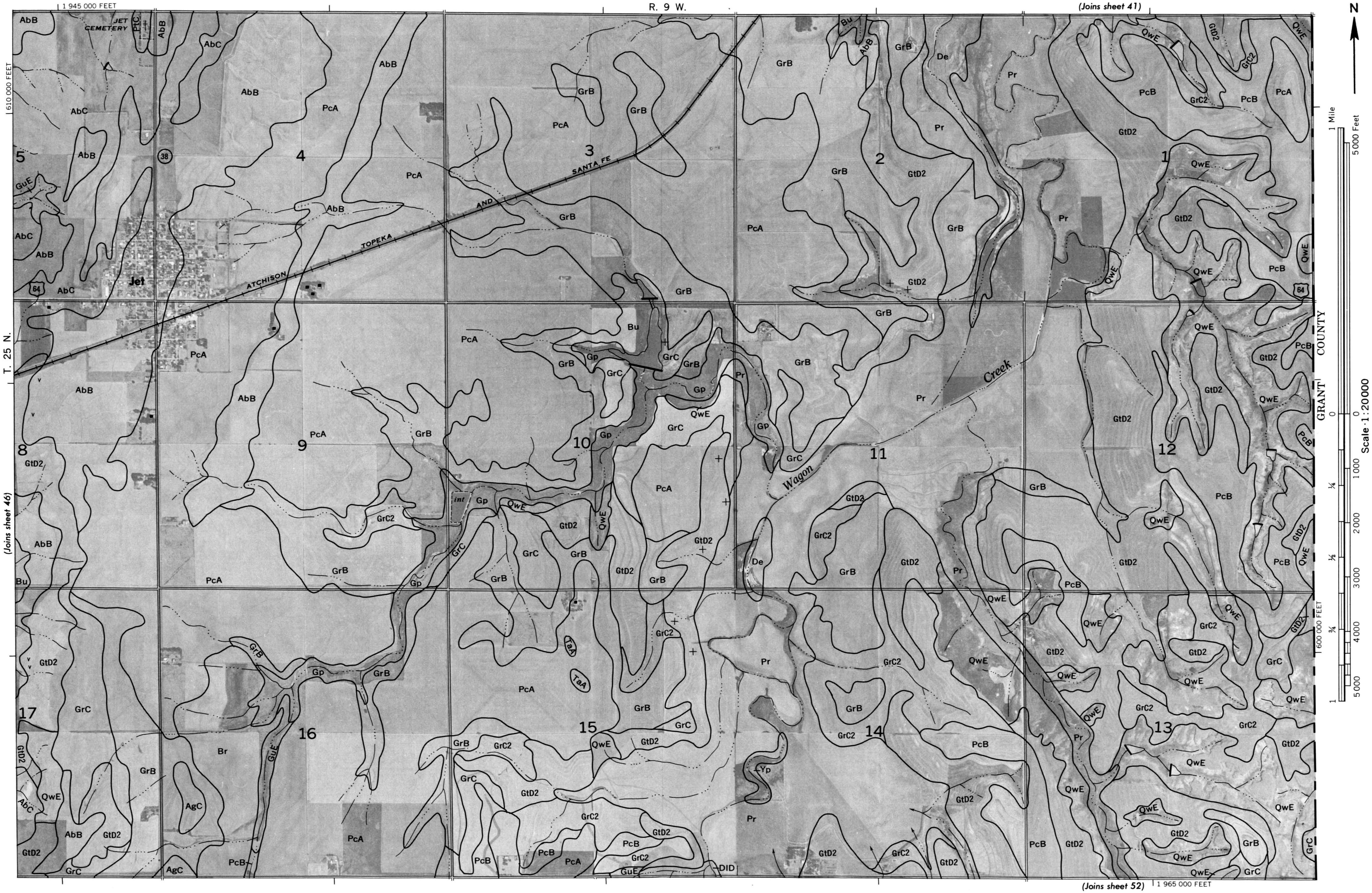
ALFALFA COUNTY, OKLAHOMA NO. 46

ALFALFA COUNTY, OKLAHOMA NO. 47

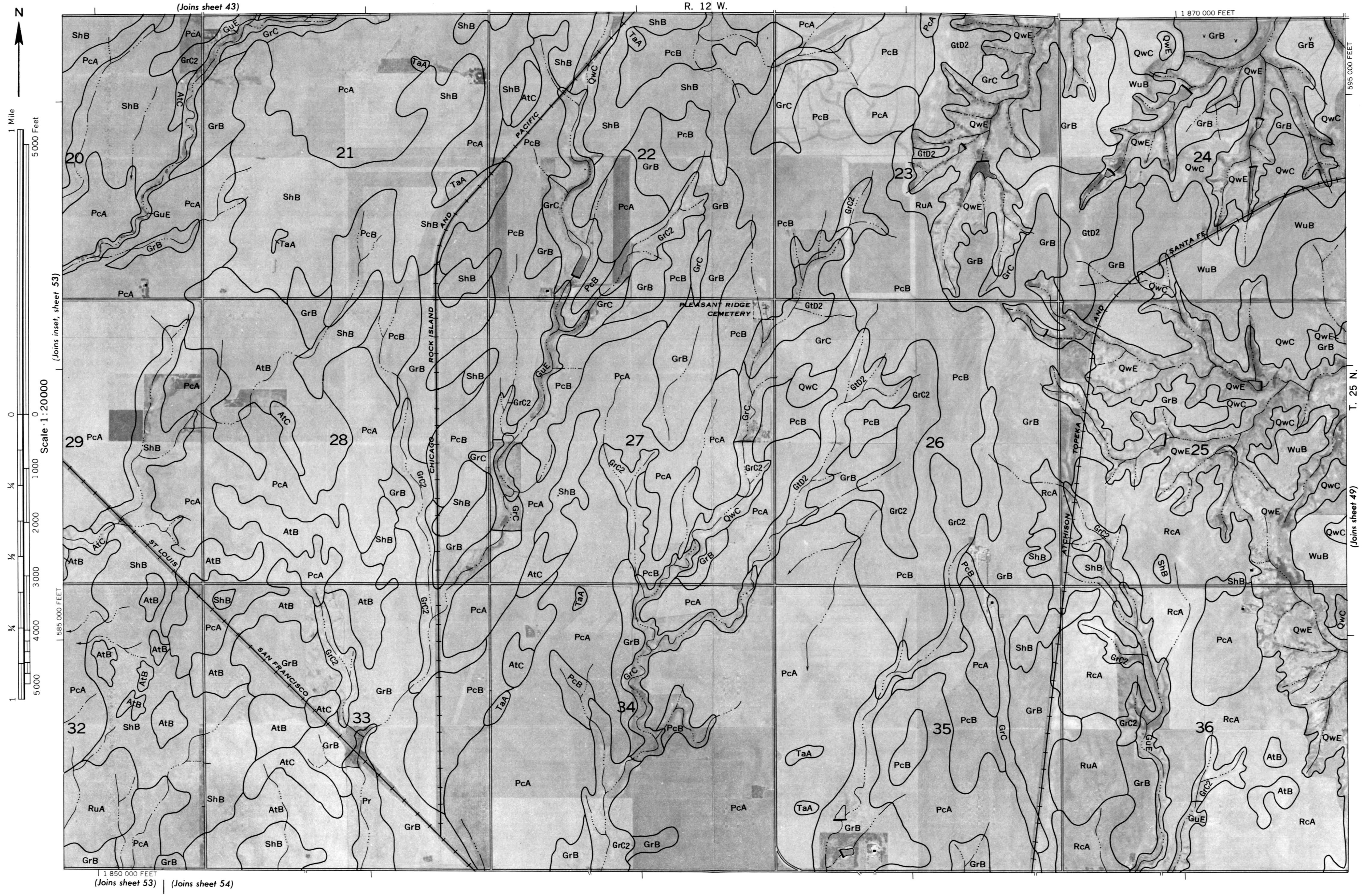
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.



ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 48



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

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ALFALFA COUNTY, OKLAHOMA NO. 48

N

Scale 1:20000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

ALFALFA COUNTY, OKLAHOMA NO. 49

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 50

Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 51

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

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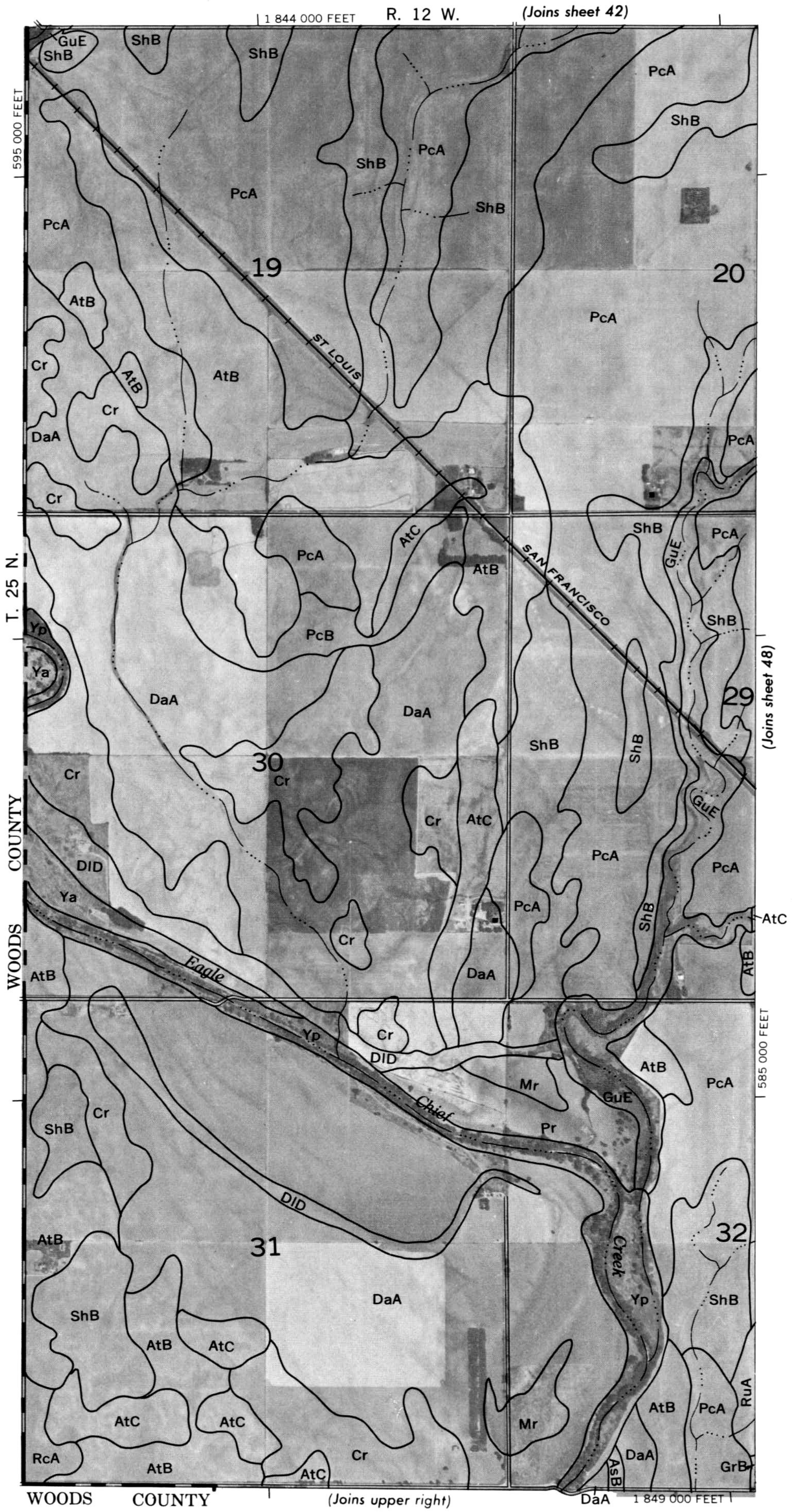
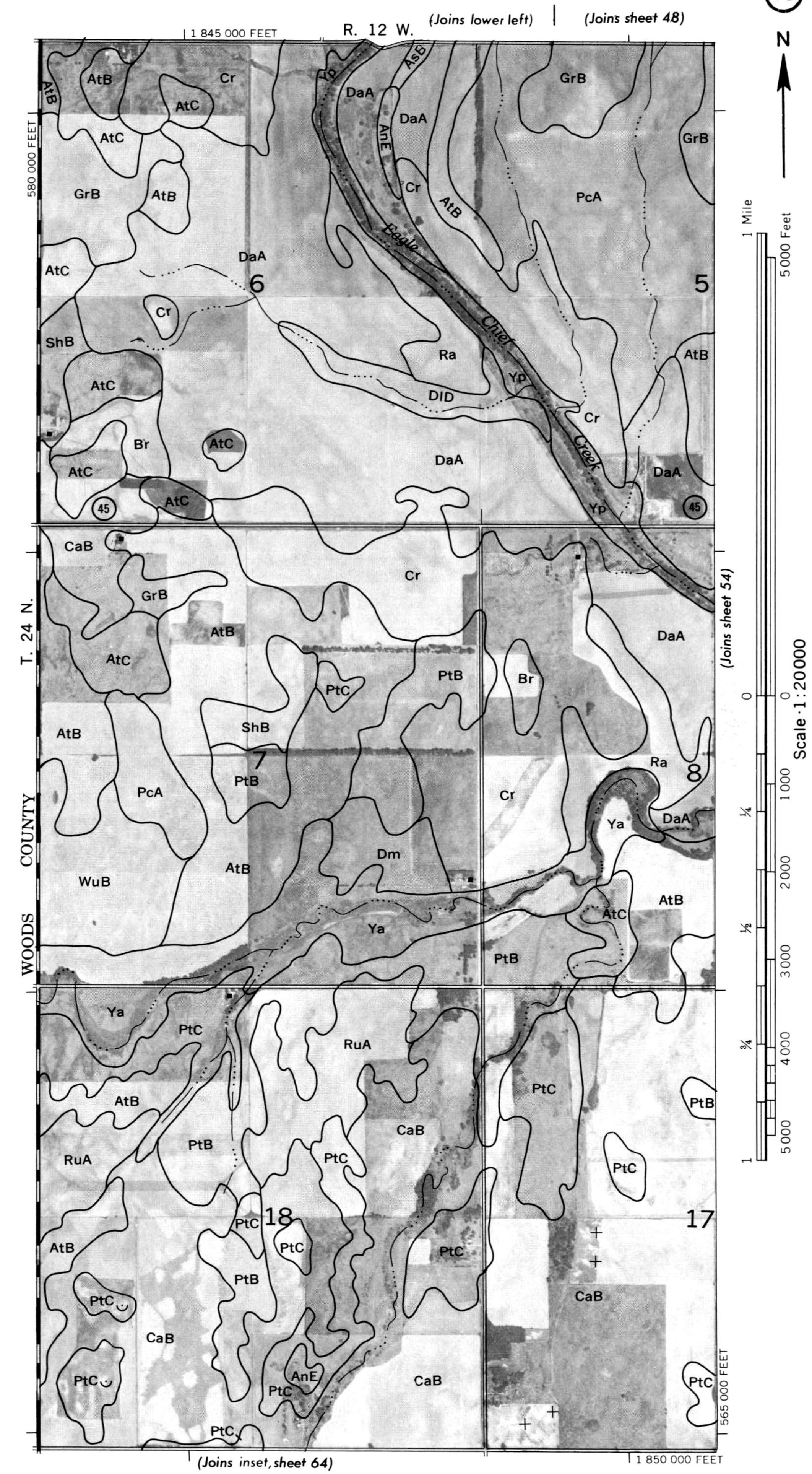
53

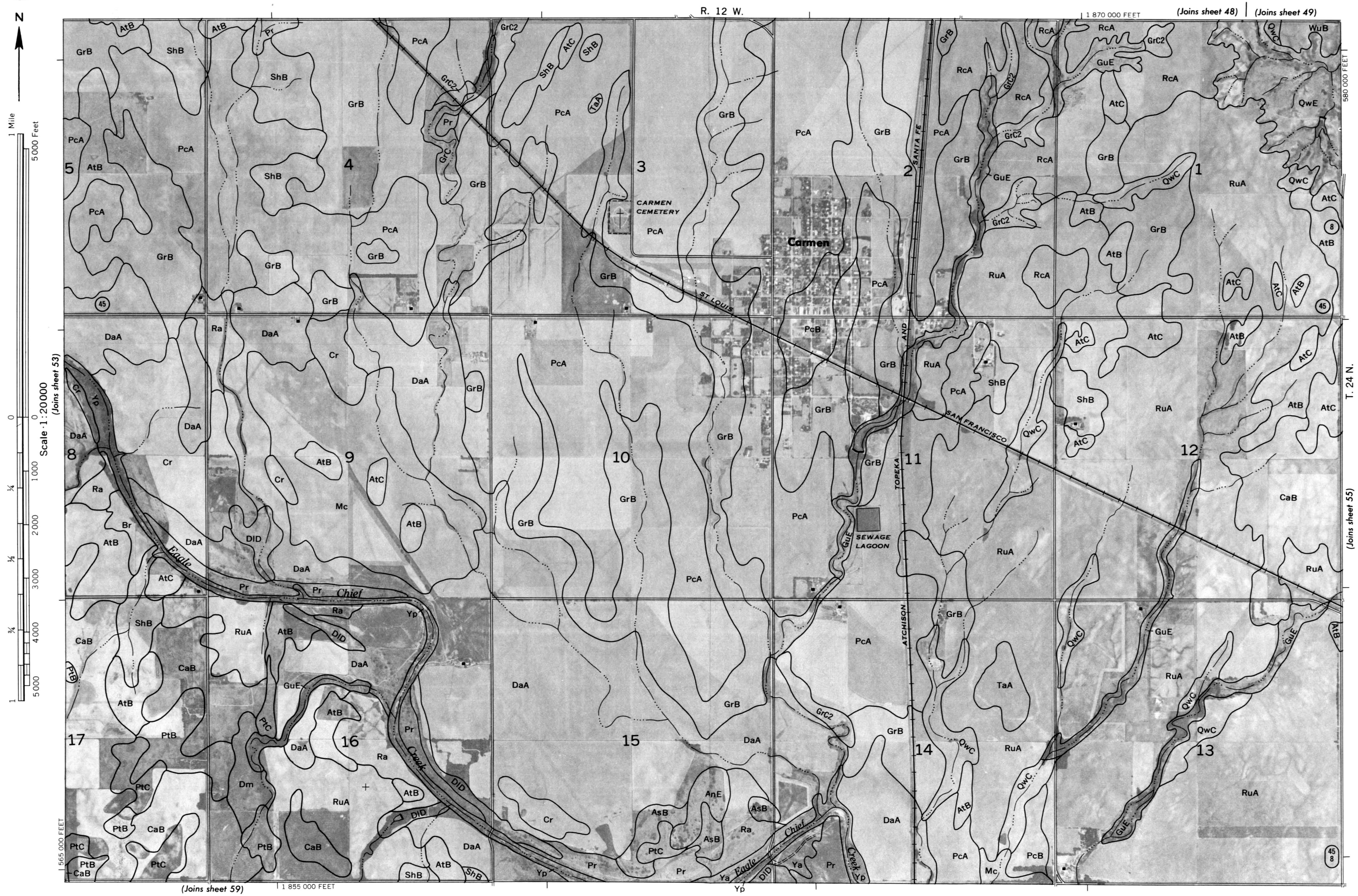
ALFALFA COUNTY, OKLAHOMA NO. 53

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.





ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 54



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

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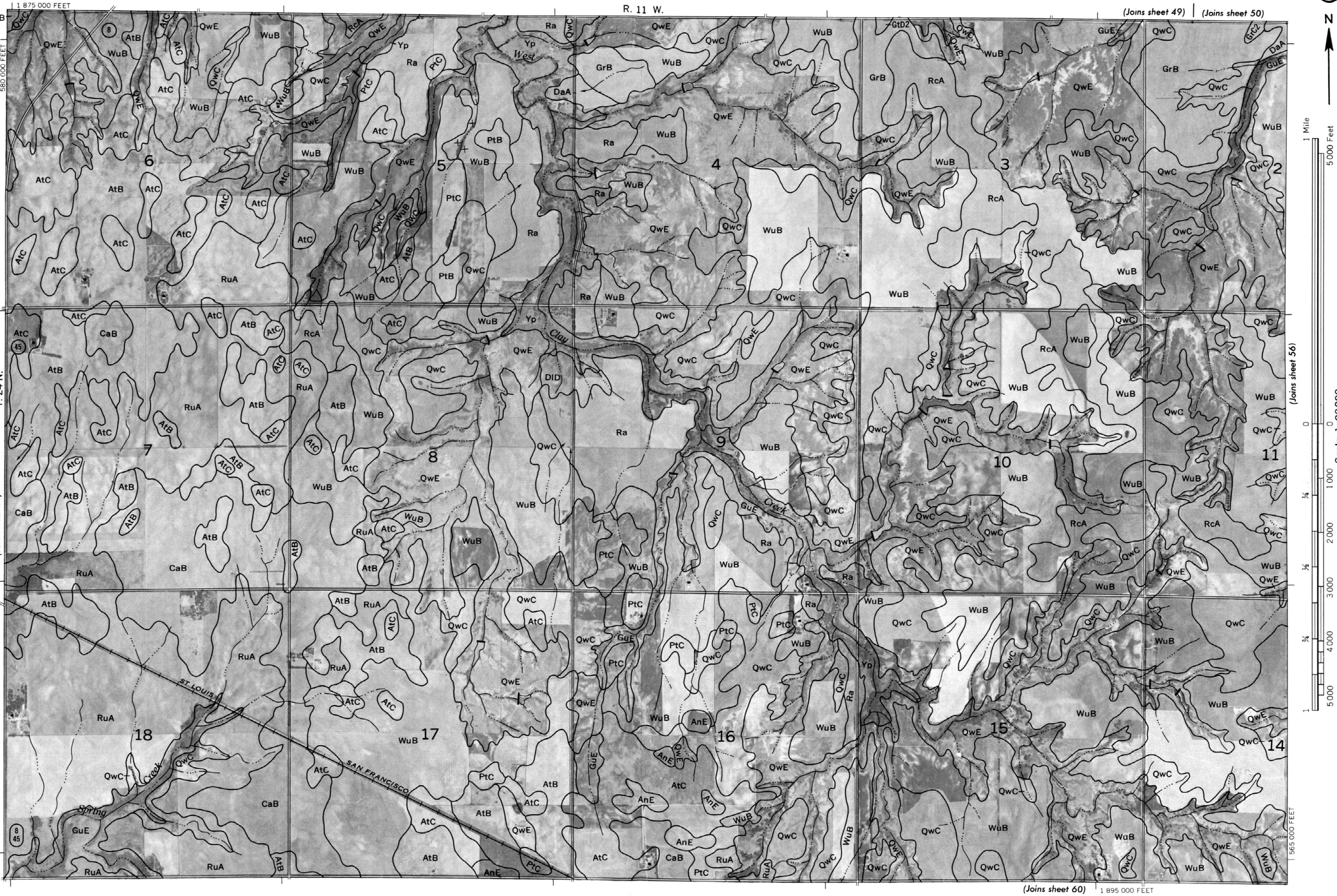
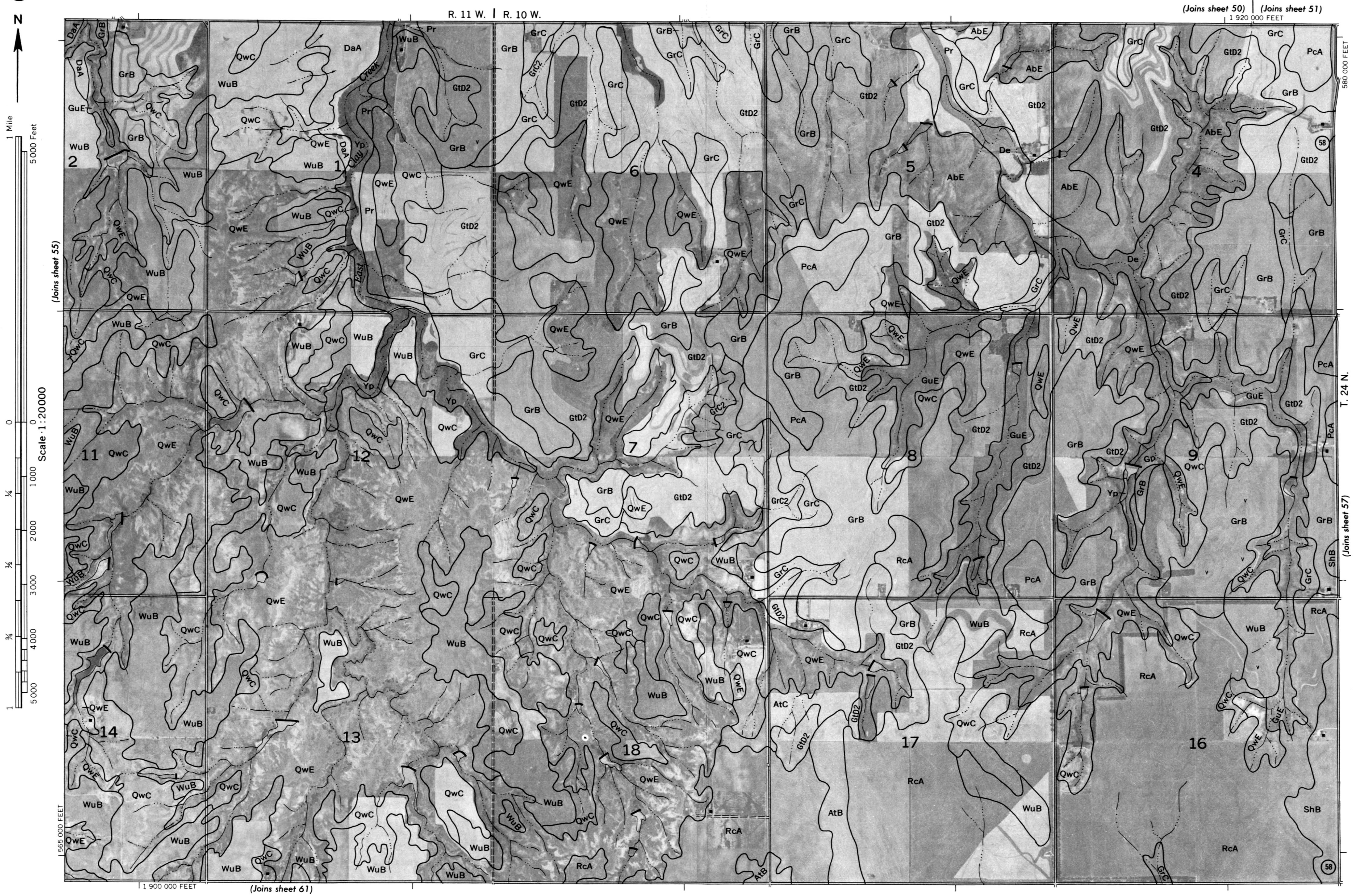
ALFALFA COUNTY, OKLAHOMA NO. 55

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 56



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

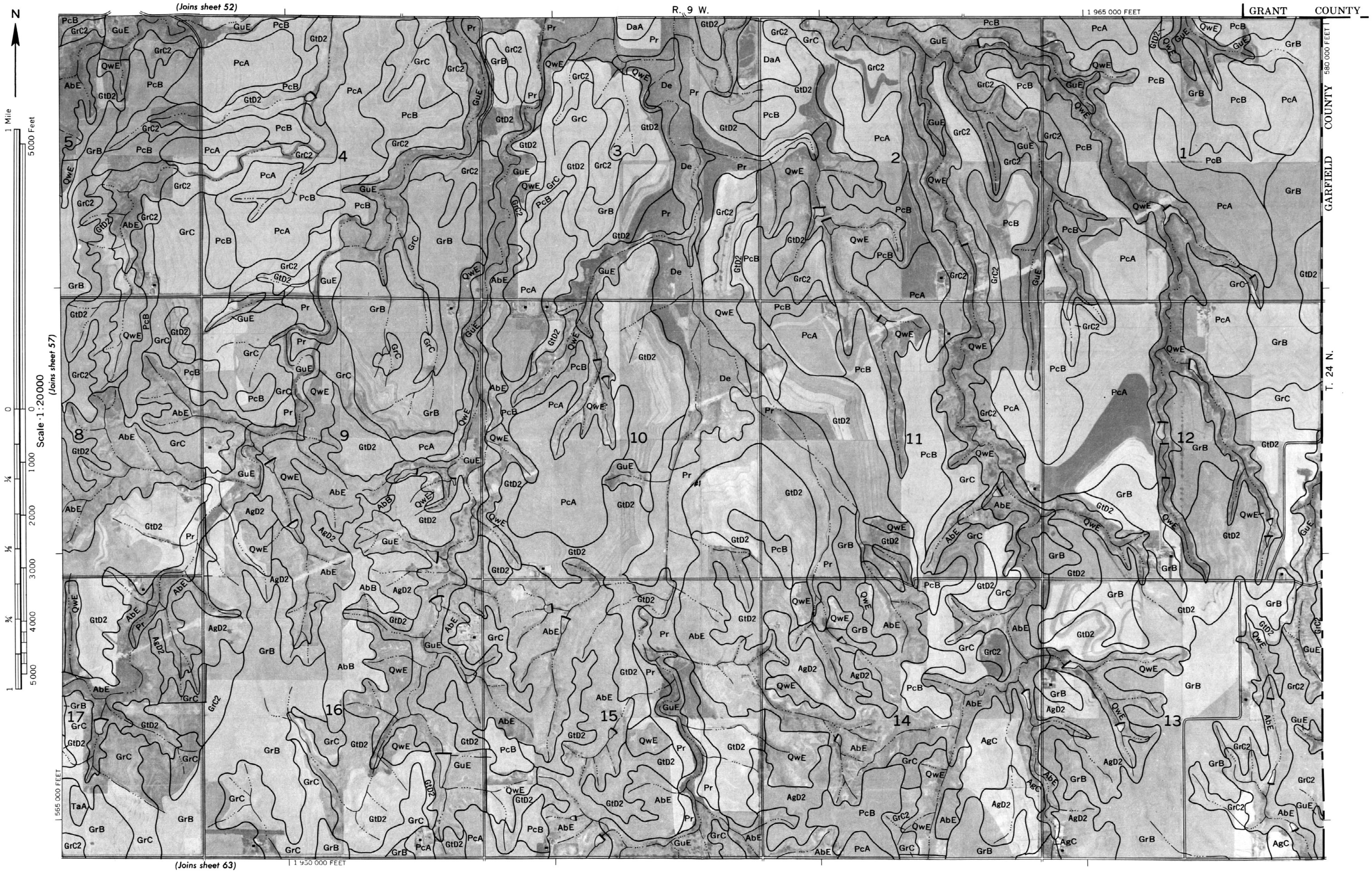
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

57

ALFALFA COUNTY, OKLAHOMA NO. 57

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 58



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

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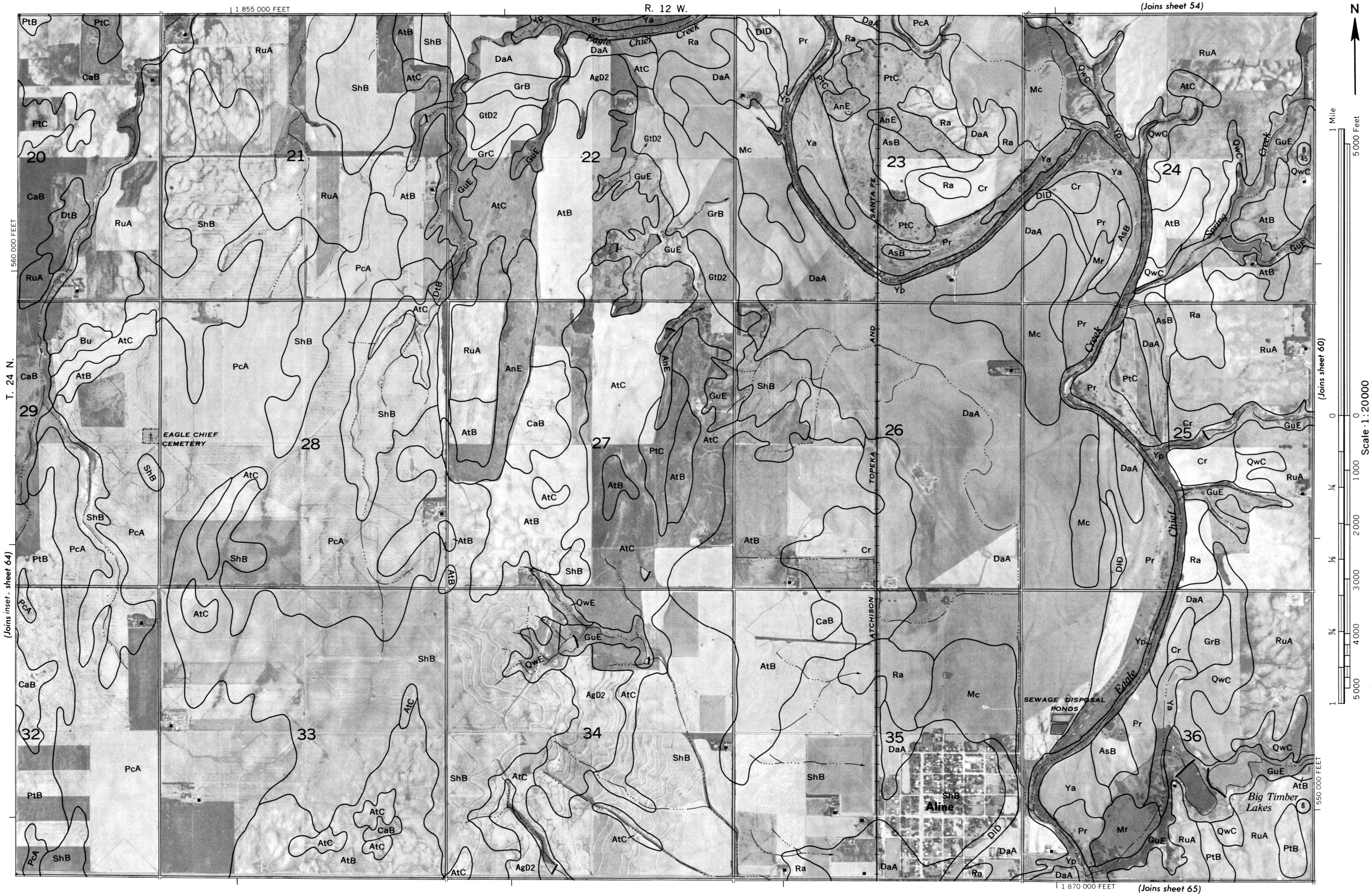
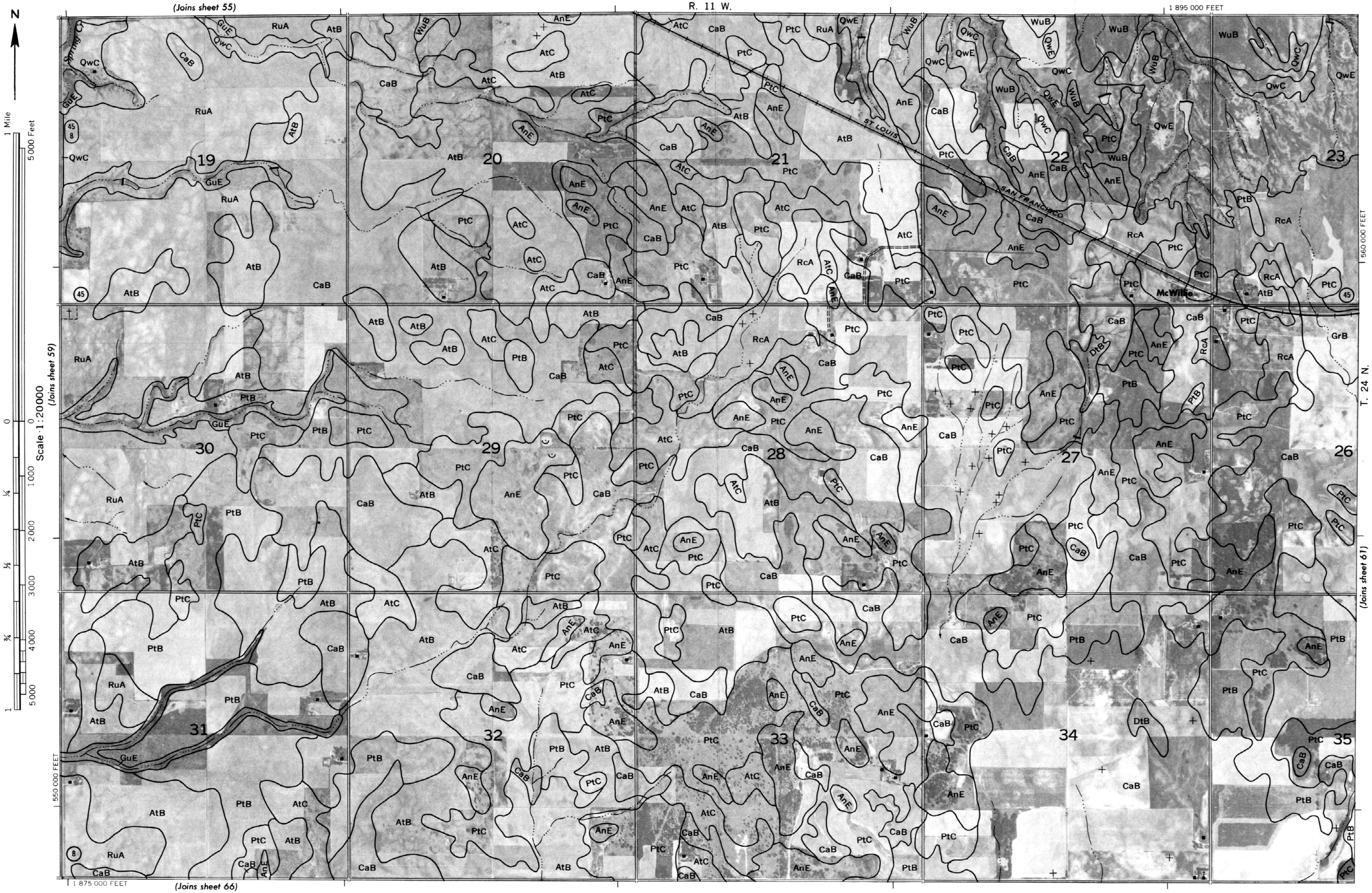
ALFALFA COUNTY, OKLAHOMA NO. 58

ALFALFA COUNTY, OKLAHOMA NO. 59

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 60



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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
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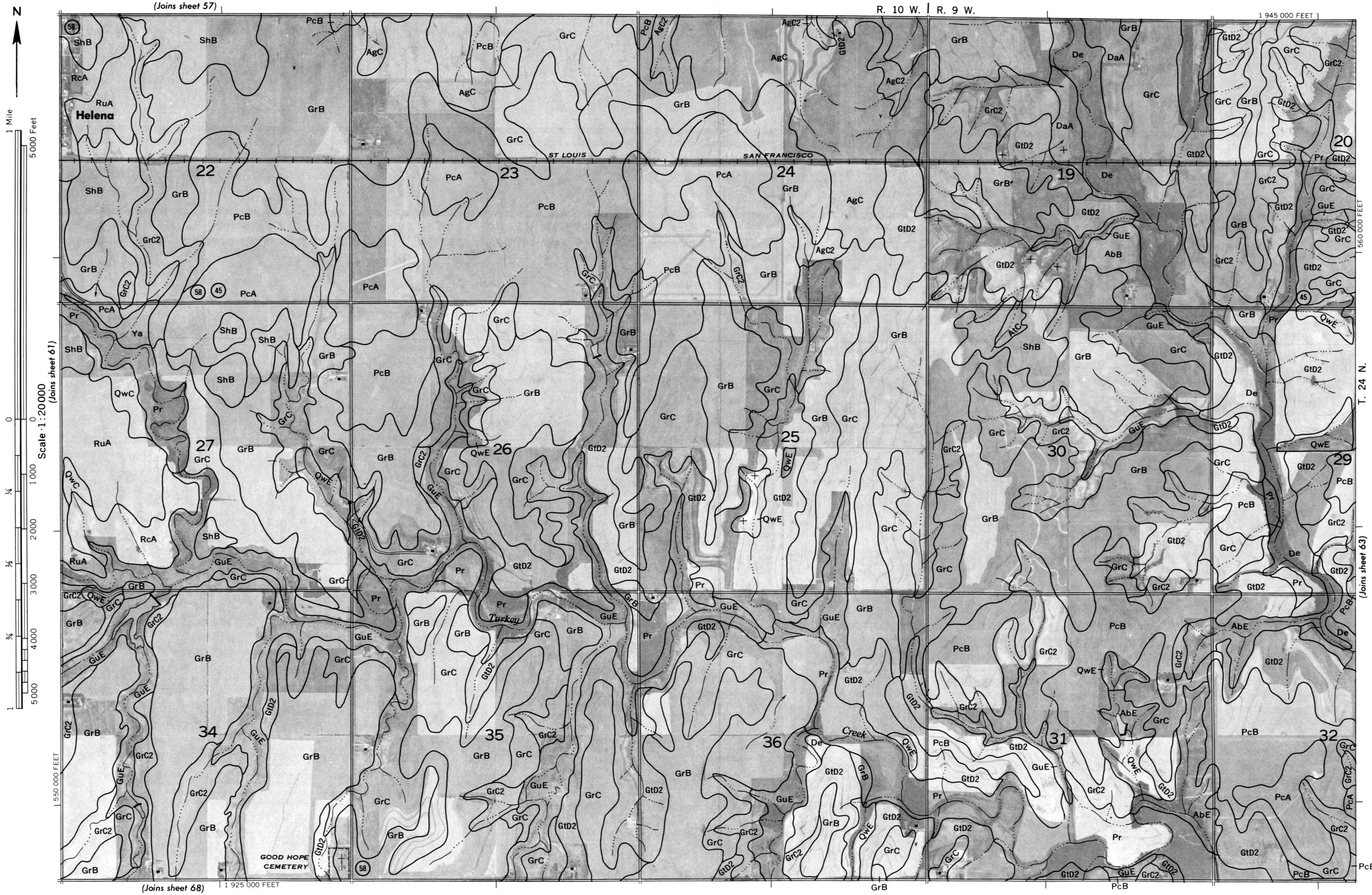
ALFALFA COUNTY, OKLAHOMA NO. 60

ALFALFA COUNTY, OKLAHOMA NO. 61

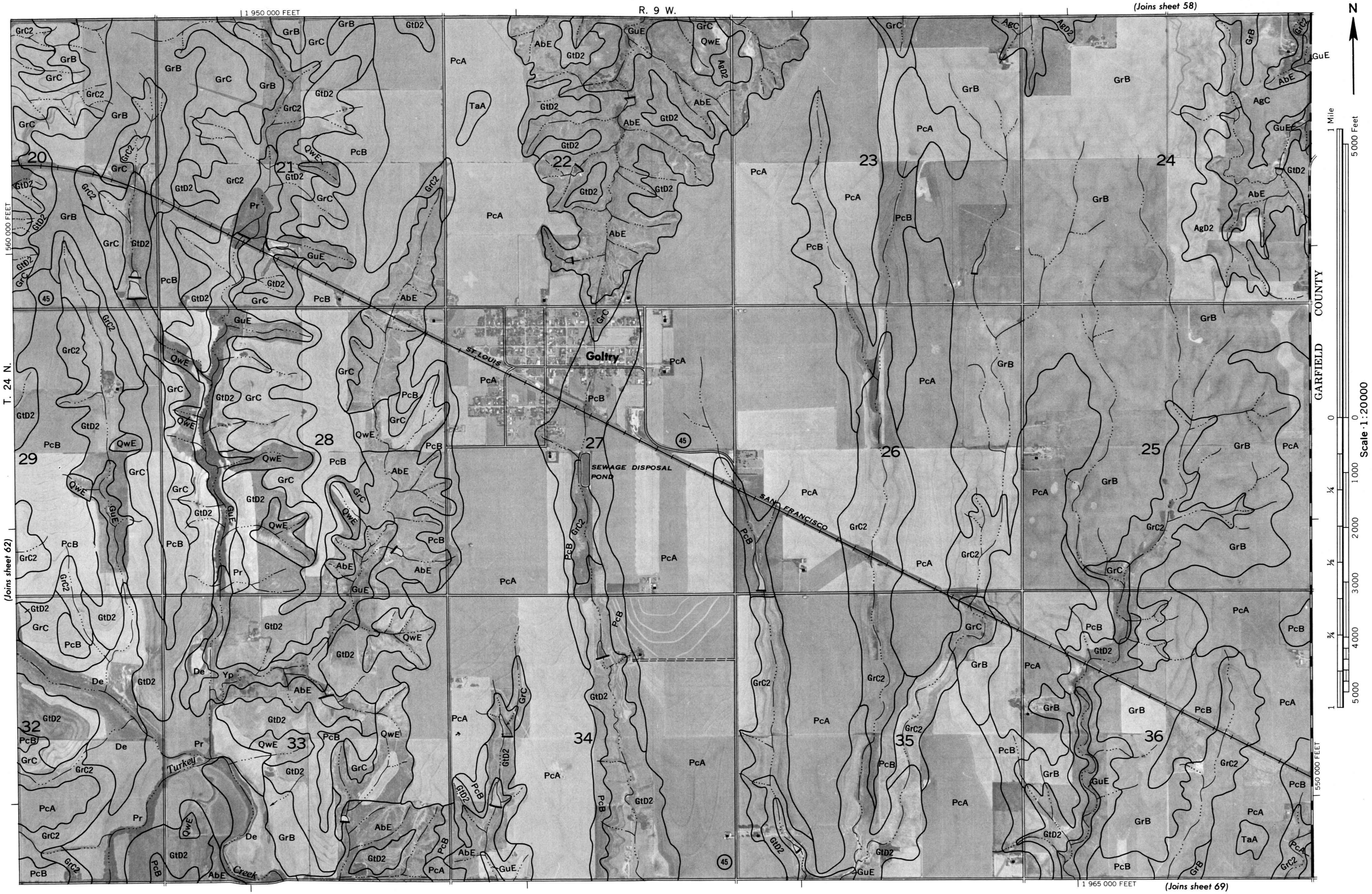
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

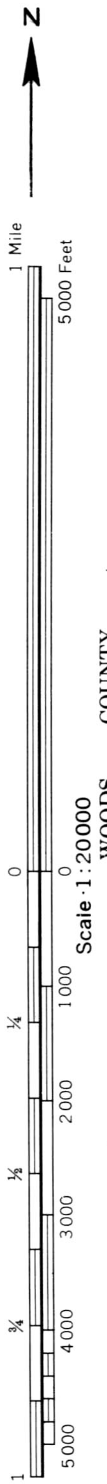
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

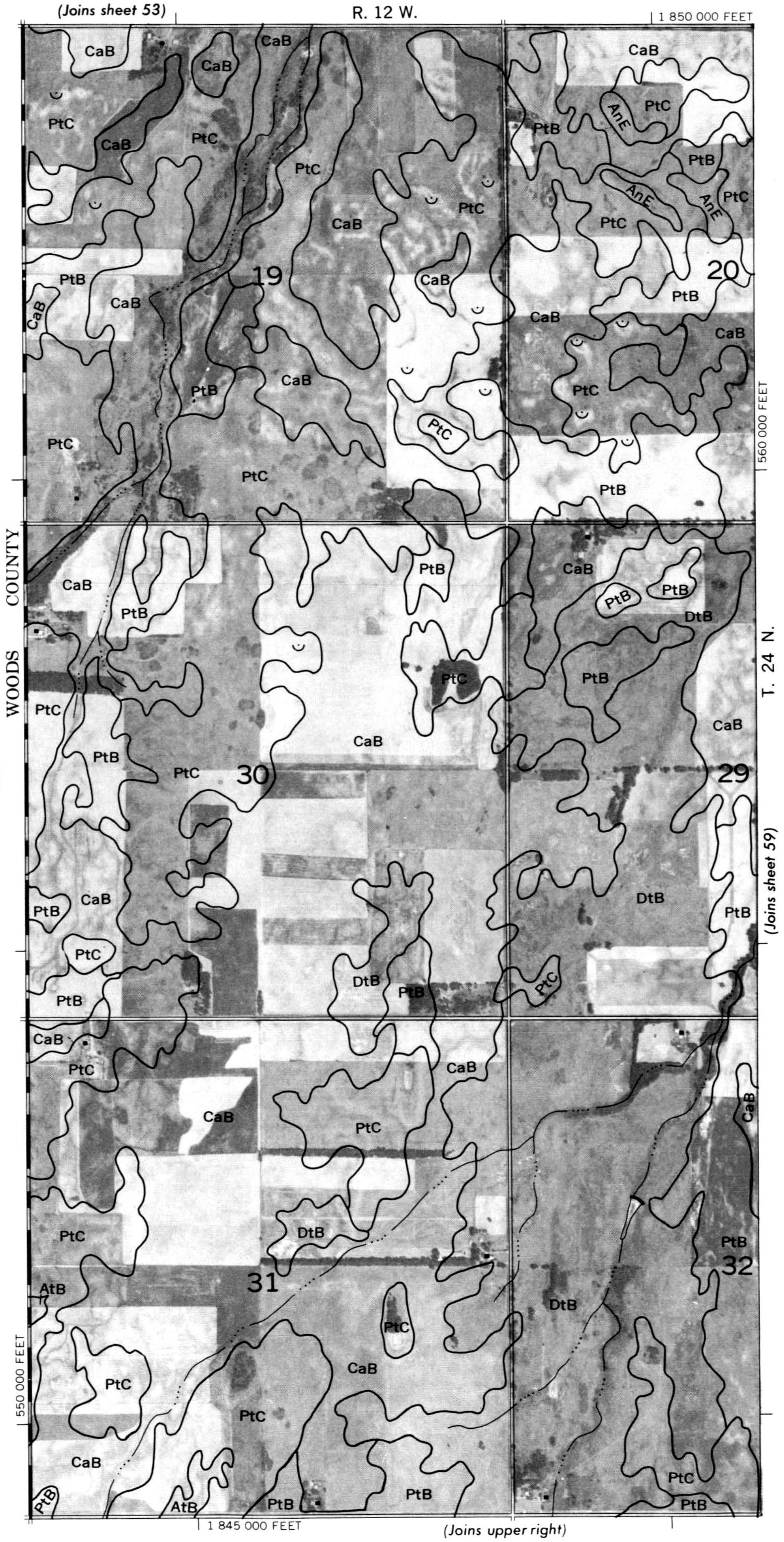
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

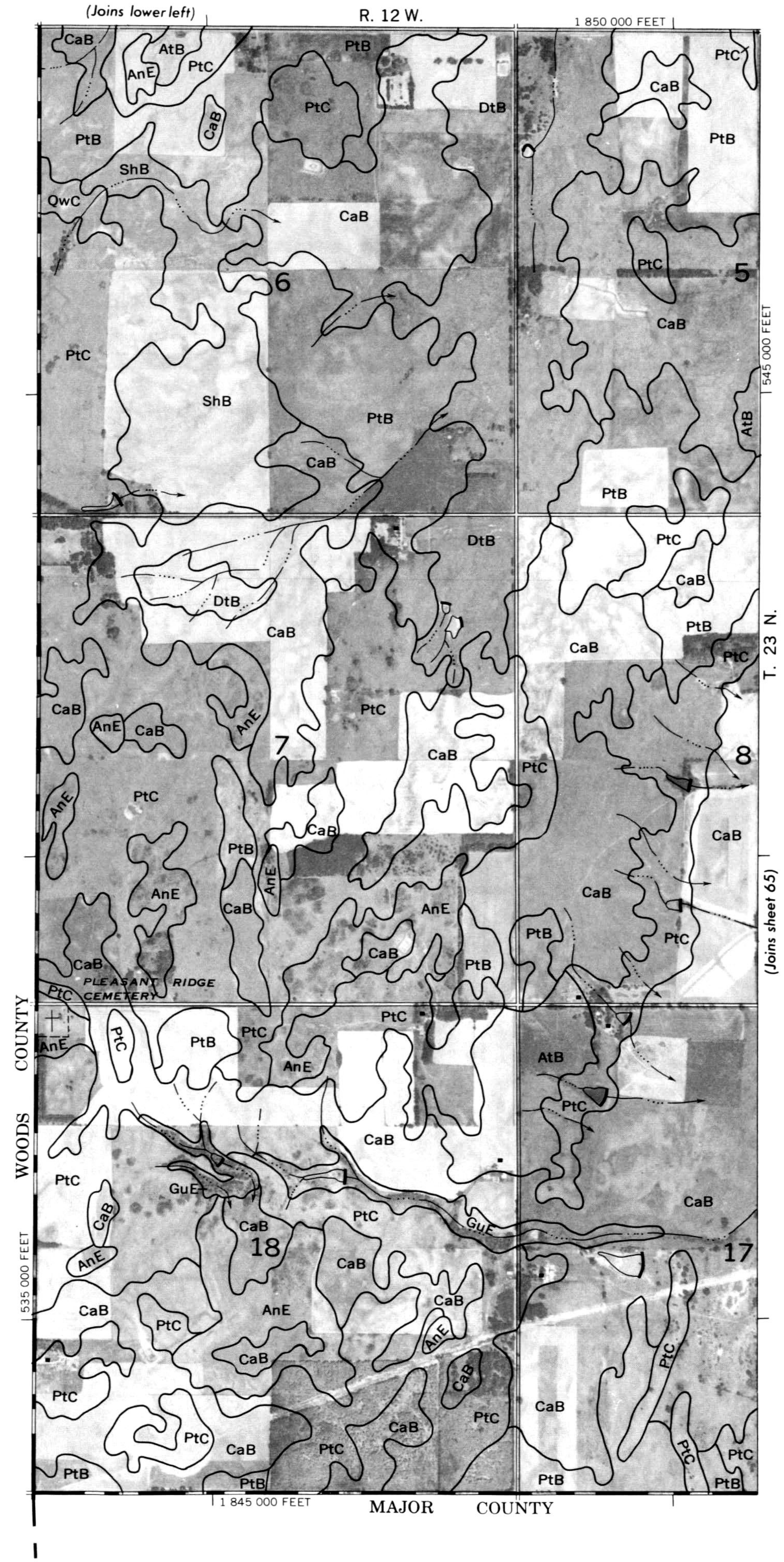


ALFALFA COUNTY, OKLAHOMA NO. 63

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone. Land division corners are approximately positioned on this map.







Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 64

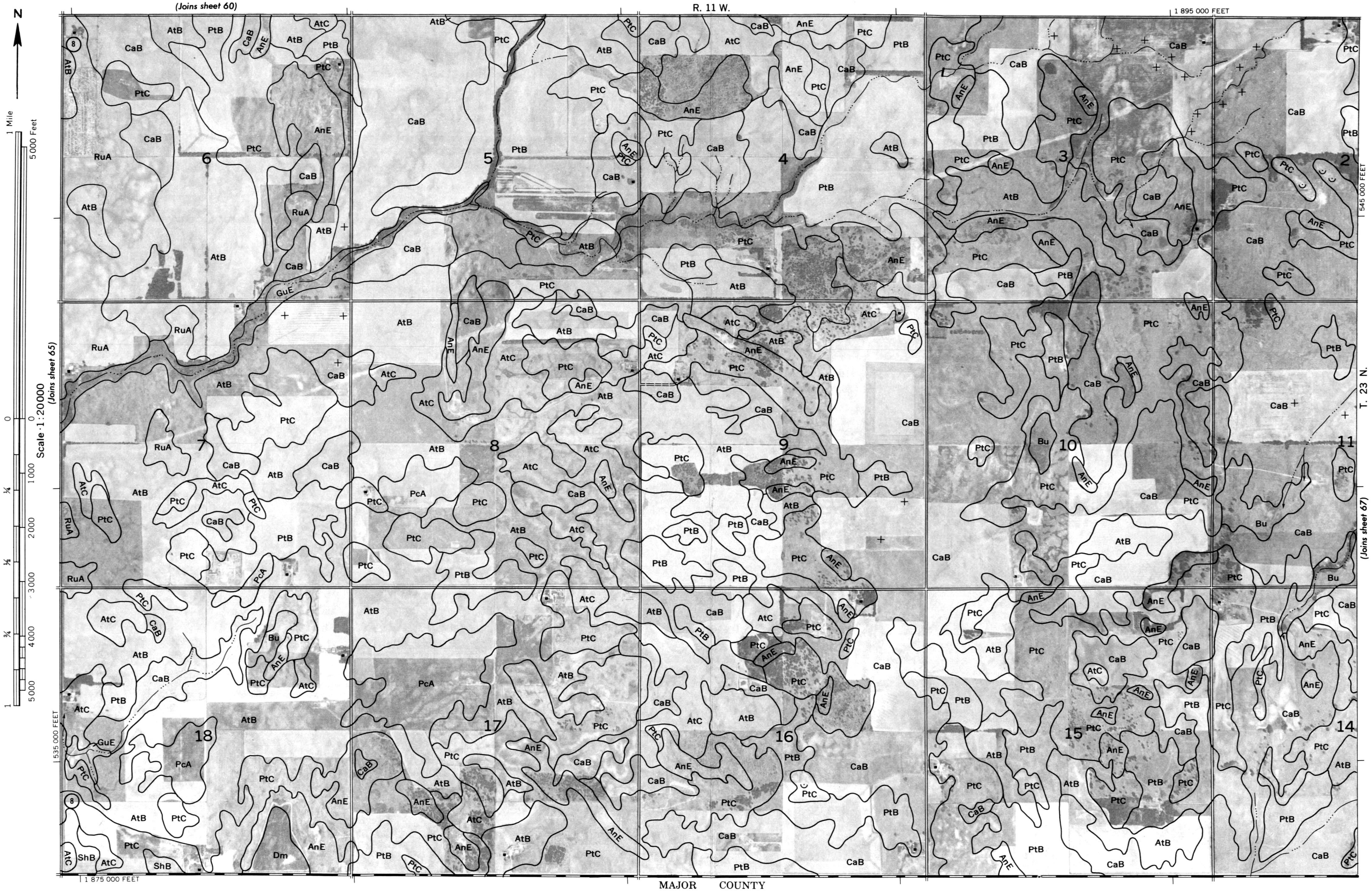
ALFALFA COUNTY, OKLAHOMA NO. 65

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.

ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 66

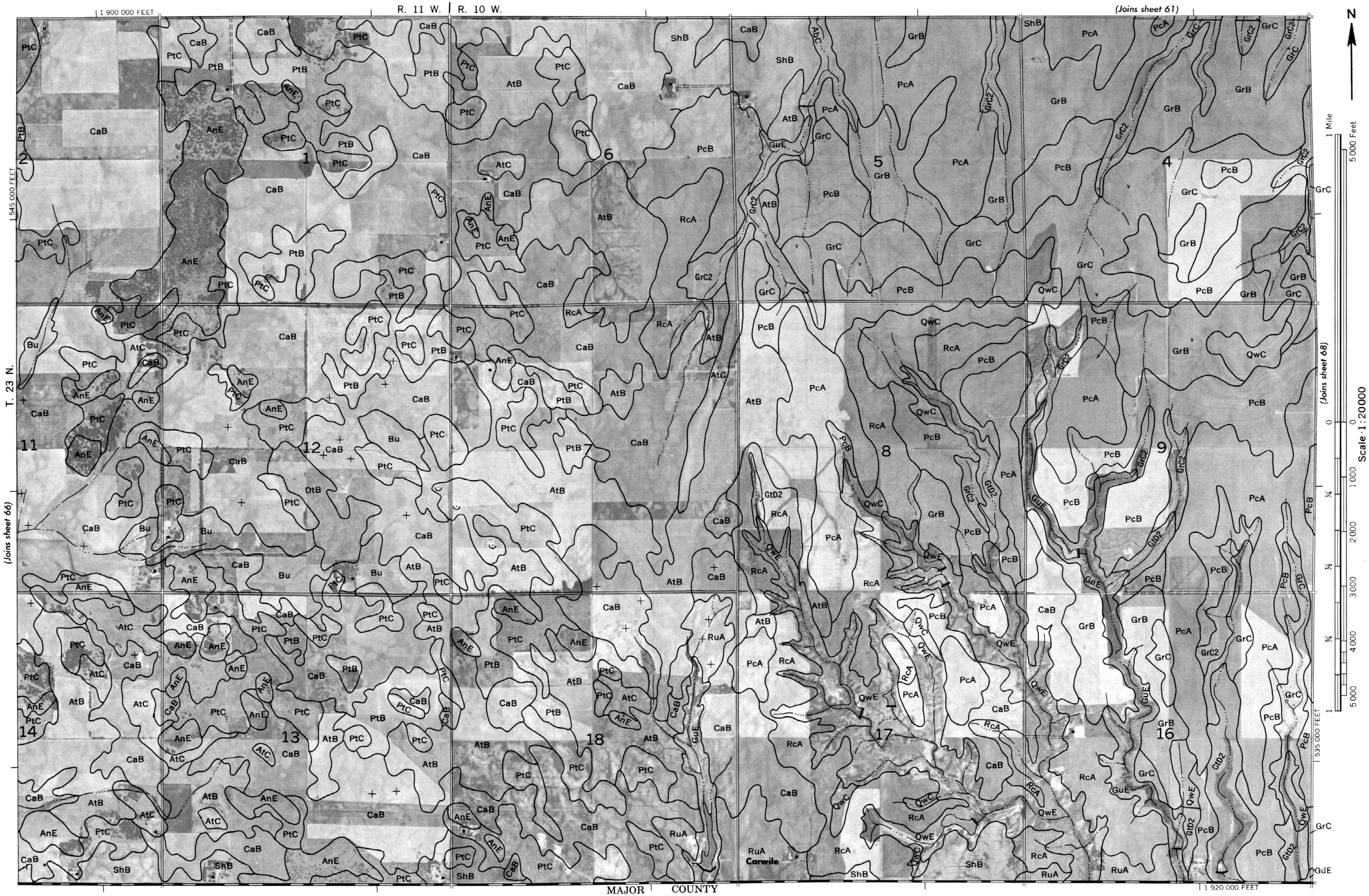


Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 66

ALFALFA COUNTY, OKLAHOMA NO. 67

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.
Land division corners are approximately positioned on this map.



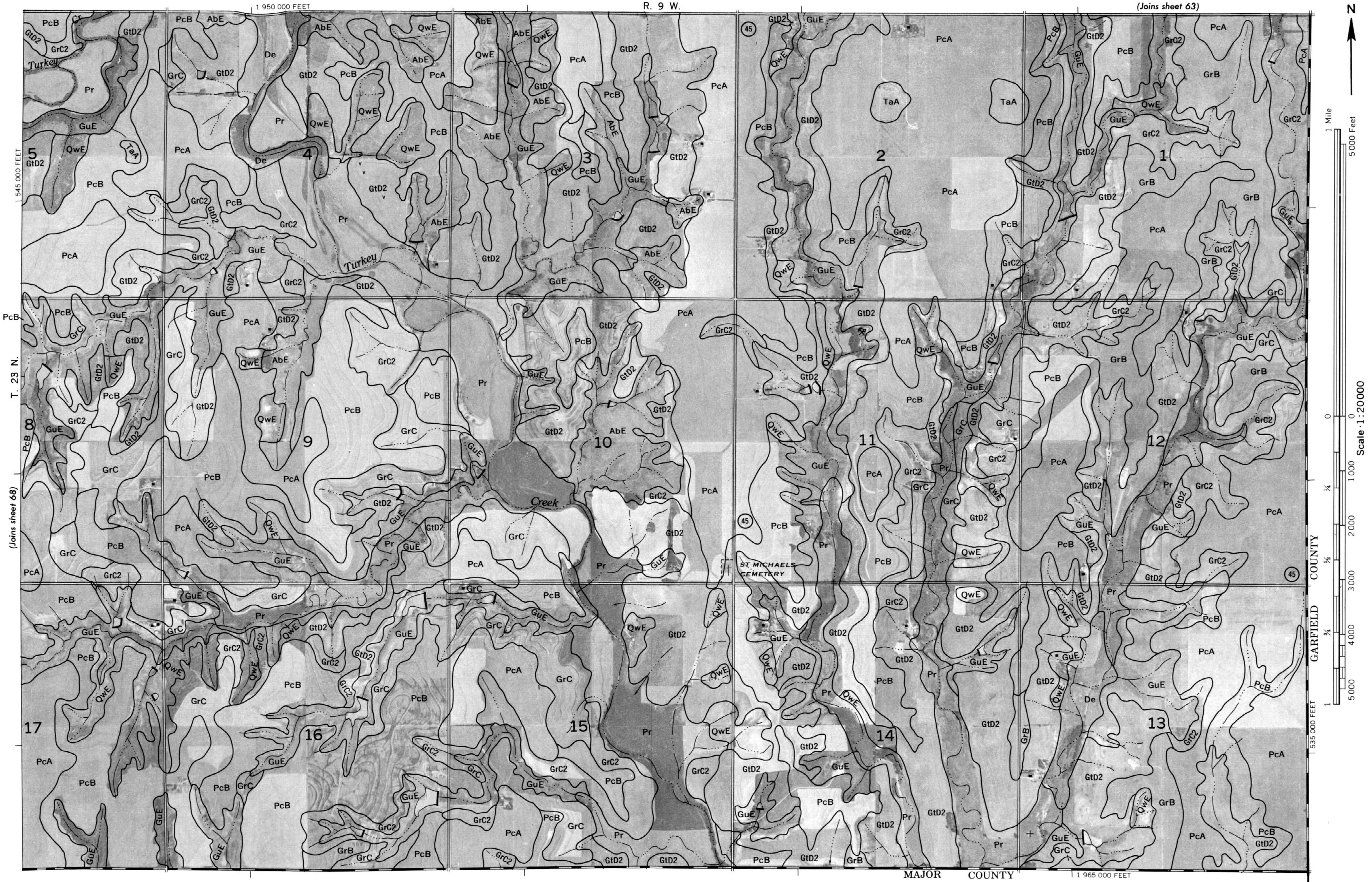
ALFALFA COUNTY, OKLAHOMA — SHEET NUMBER 68

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

ALFALFA COUNTY, OKLAHOMA NO. 68



ALFALFA COUNTY, OKLAHOMA NO. 69

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Oklahoma Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Oklahoma coordinate system, north zone.

Land division corners are approximately positioned on this map.